Name of Institute: Indus Institute of Technology and Engineering, Indus University Ahmedabad
Name of Faculty: Prof. Indr Jeet Rajput

Course code: **CE0418**
Course name: **Operating System**
Pre-requisites: Basic Programming.
Credit points: 4
Offered Semester: 4th

Course Coordinator (weeks 12):
Full Name: Prof. Indr Jeet Rajput
Department with sitting location: Computer Engineering, first floor Computer Lab-127, Bhanwar Building
Telephone: 9662613960
Email: indrrajput.ce@indusuni.ac.in
Consultation times: 3.00 P.M. to 5.00 P.M. (Monday to Friday)
Course Lecturer (weeks 12)
Full Name: Prof. Indr Jeet Rajput/Ms. Pooja Sisodiya
Department with sitting location: Computer Engineering, Staff Area, Third floor , Bhanwar Building
Telephone-
Email: poojasisodiya.ce@indusuni.ac.in
Consultation times: 3.00 P.M. to 5.00 P.M. (Monday to Friday)

Students will be contacted throughout the Session via Mail with important information relating to this Course.

Course Objectives

On completion of this course, a student will be familiar with different types of operating system and their working. They are able to understand the basic components of a computer operating system, and the interactions among the various components. The course will cover an introduction on the policies for scheduling, deadlocks, memory management, synchronization, system calls, and file systems. The students will implement solutions via C/C++ programs and shell script.

Course Outcomes (CO)

After successful completion of the course, student will able:

1. Understand various generations of Operating System and functions of Operating System
2. Understand the concept of program, process and thread and Analyze various CPU Scheduling Algorithms and compare their performance.

3. Solve Inter Process Communication problems using Mathematical Equations by various methods.
4. Understand File Systems in Operating System like UNIX/Linux and Windows.
5. Write shell scripts in Linux/UNIX environment.
6. Understand Security Management of Operating System.

Course Outline

Processor management, multiplexing, interrupts, multiprocessing, Memory management, partitions, swapping, paging, disks, files, directories, Input/Output, buffering. Job scheduling. Networks. Case study.

Unit-I

[12]

Introduction to Operating System:

Architecture of OS (Ex. Monolithic, Microkernel, Layered , Exo kernel), Operating system objectives and functions, Virtual Computers, Interaction of O. S. & hardware architecture, Evolution of operating systems, Batch, multiprogramming. Multitasking, Multiuser, parallel, distributed & real –time O.S., System calls, O. S. Shell, Linux Shell commands, Shell programming. Examples of O. S.: Linux, MS-Windows, Handheld OS.

Process Management:

Process, Process description, Process states, Process control, Threads, Processes and Threads, Uniprocessor Scheduling: Types of scheduling, Scheduling algorithms: FCFS, SJF, Priority, Round Robin, UNIX Multi-level feedback queue scheduling, Thread Scheduling, Multiprocessor Scheduling concept, Real Time Scheduling concept

Unit-II

[12]

Concurrency:

Principles of Concurrency, Critical Section problem, Mutual Exclusion H/W Support, software approaches, Semaphores and Mutex, Message Passing, Monitors, Classical Problems of Synchronization: Readers-Writers Problem, Producer Consumer Problem, Dining Philosopher problem

Deadlock:

System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.

Unit-III **[12]**

Memory Management:

Memory Management requirements, Memory partitioning: Fixed ,dynamic, partitioning, Contiguous memory allocation, Buddy System Memory allocation Strategies (First Fit, Best Fit, Worst Fit, Next Fit), Fragmentation, Swapping, Segmentation , Paging, Virtual Memory, Demand paging, Page Replacement Policies (FIFO, LRU, Optimal, clock) ,Thrashing.

I/O Management and Disk Scheduling:

I/O Devices, Organization of I/O functions, Operating System Design issues, I/O Buffering, Disk Scheduling (FCFS, SCAN, C-SCAN, SSTF), Disk Caches.

Unit-IV [12]

File Management:

Overview, File Organization and access, File Directories, File Sharing, Security issues, Record Blocking, Secondary Storage Management.

Computer security & protection:

Security Threats, Attacks and assets, Intruders, Malicious software, Protection: Protection Policy and mechanisms, Authentications: Internal Access Authorizations, Implementations.

Method of delivery

- Face to face lectures, self-study material, Active Learning Techniques
- Live screen sharing of practical
- PPT
- Online Zoom/webex/Google meet Learning

Study time

Lecture	Tutorial	Practical	Credits
3	0	2	4

CO-PO Mapping (PO: Program Outcomes)

1 Program Outcomes (PO's)

Engineering Graduates will be able to:

PO1 **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6 **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

2. Programme Specific Outcome

Computer Engineering

1. To understand the principles and working of computer systems.
2. To Design and develop computer programs in the areas related to algorithms, networking, web design, cloud computing, IoT and data analytics.

COURSE OUTCOME (CO) and PROGRAM OUTCOME (PO) Matrix

(1- Low, 2-Medium, 3- High)

(Average of COs course wise for each POs)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C0 1	3.00	2.00	3.00	3.00	2.00	-	-	-	-	-	-	-
C0 2	3.00	1.00	3.00	2.00	2.00	-	-	-	-	-	-	2.00
C0 3	1.00	3.00	2.00	2.00	2.00	-	-	-	-	-	-	-
C0 4	2.00	2.00	2.00	2.00	2.00	-	-	-	2.00	2.00	2.00	-
C0 5	2.00	2.00	2.00	2.00	1.00	-	-	-	-	-	-	-
C0 6	2.00	1.00	3.00	2.00	2.00	-	-	-	-	2.00	2.00	-
CE0418	**2.17**	**1.83**	**2.50**	**2.17**	**1.83**	**-**	**-**	**-**	**2.00**	**2.00**	**2.00**	**2.00**

Average = (total of all COs for each PO)/(no of entries in that PO)

Average should not be less than 1
Make sure based on respective
COURSE OUTCOME and PROGRAM SPECIFIC OUTCOME Matrix

Operating system (CE)

CO	PSO1	PSO2
CO 1	3.00	2.00
CO2	2.00	2.00
CO 3	1.00	2.00
CO 4	2.00	1.00
CO 5	1.00	2.00
CO 6	1.00	1.00
	1.67	**1.67**

Blooms Taxonomy and Knowledge retention (For reference)

(Blooms taxonomy has been given for reference)

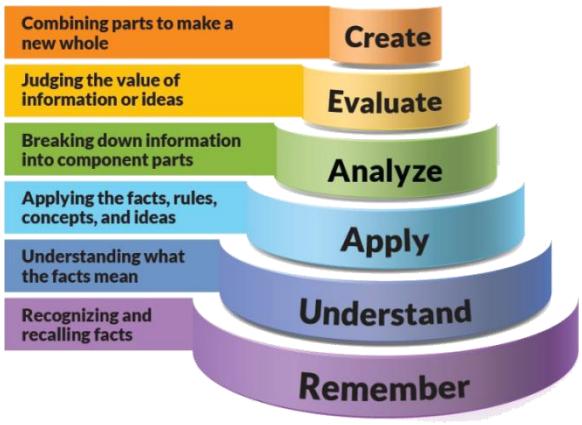

Figure 1: Blooms Taxonomy

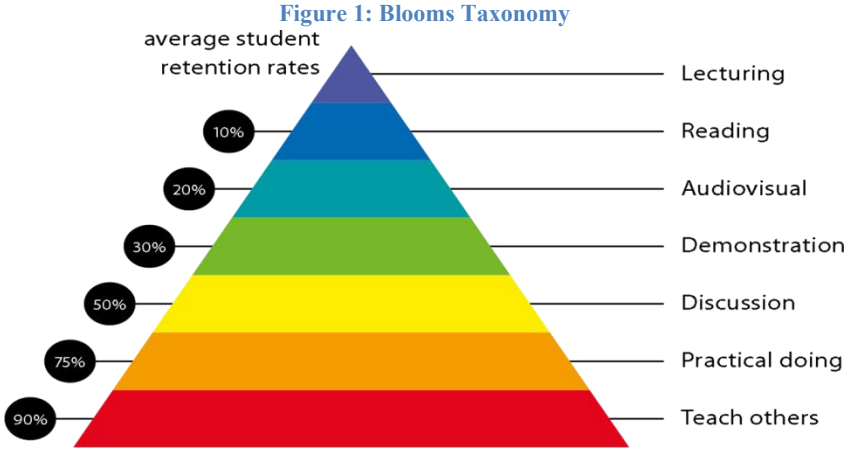

Figure 2: Knowledge retention

Practical work:

Wk No.	Class Activity	List of Practical

01	Lab 1	Study of Basic commands of Linux/UNIX
02	Lab 2	Study of Advance commands and filters of Linux/UNIX.
03	Lab 3	Write a shell script to generate marksheet of a student. Take 3 subjects, calculate and display total marks, percentage and Class obtained by the student.
04	Lab 4	Write a shell script to find factorial of given number n.
05	Lab 5	Write a shell script which will accept a number b and display first n prime numbers as output.
06	Lab 6	Write a shell script which will generate first n Fibonacci numbers like: 1, 1, 2, 3, 5, 13,...
07	Lab 7	Display calendar of current month Display today's date and time Display usernames those are currently logged in the system Display your name at given x, y position. Write a shell script to read n numbers as command arguments and sort them in descending order. Write a shell script to display all executable files, directories and zero sized files from current directory.
08	Lab 8	Write a shell script to check entered string is palindrome or not.. Shell programming using filters (including grep, egrep, fgrep) Study of Unix Shell and Environment Variables. Write a shell script to validate the entered date. (eg. Date format is : dd-mm-yyyy) Write an awk program using function, which convert each word in a given text into capital. Write a program for process creation using C. (Use of gcc compiler).
09	Lab 9	The distance between two cities (in km.) is input through the keyboard. Write a shell script to convert and print distance in meters, feet, inches and centimetres. Write a shell script to input two no's from the user and perform addition, subtraction, multiplication, and division. Any integer is input through the keyboard. Write a shell script to find out whether it is an odd number or even number. Write a shell script which receives any year form the keyboard and determines whether the year is a leap year or not. If no argument is supplied the current year should be assumed. Write a shell script which receives two file names as arguments. It should check whether the two file's contents are same or not. If same then the second file should be deleted.
10	Lab 10	Write a shell script to print the series 1, 3, 5, 7, 9, ……., N. Write a program to print all prime no's from 1 to 300. (Hint – Use Nested Loops, break and continue) Write a shell script which deletes all lines containing the word unix in the files as arguments to this shell script.

Practical Beyond syllabus		
11	Lab 11	Introduction of other types of operating systems.

Lecture/tutorial times

(Give lecture times in the format below)

as per university norms is compulsory for being eligible for mid and end semester examinations.

Details of referencing system to be used in written work

Text books:

Text Books

1. Operating System Concepts (8th Edition) by Silberschatz, Peter B. Galvin and Greg Gagne, Wiley- Indian Edition (2010).
2. Modern Operating Systems (Third Edition) by Andrew S Tanenbaum, Prentice Hall India (2008).

Reference Books

1. Principles of Operating Systems by Naresh chauhan, Oxford Press (2014).
2. Operating Systems by D.M. Dhamdhere, Tata McGraw Hill 2nd edition.
3. Unix Concept and application by Sumitabha Das,Tata Macgrow Hill
4. Unix Shell Programming by Yashwant Kanetkar,BPB Publication.Pearson Education

Additional Materials

1) http://www.nptel.ac.in/
2) https://www.tutorialpoint.com/os/

ASSESSMENT GUIDELINES

Theory:	***Practical:***
CIE-TH(60)	**CIE-PR(60)**
Mid Exam [40 Marks]	Quiz[20 Marks]
Assignment [10 Marks]	Lab file [20 Marks]
Class Test [10 Marks]	Presentation or Test [20 marks]

Your final course mark will be calculated from the following:

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in mid semester or end semester will be considered for supplementary assessment in the respective components (i.e mid semester or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (mid semester or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Practical Work Report/Laboratory Report:

A report on the practical work is due the subsequent week after completion of the class by each group.

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of 5% of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

University and Faculty Policies

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

Plagiarism - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment)

Course schedule (subject to change)

(Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	Introduction: Basics of Operating Systems, Definition, Types of Operating Systems	1,2	Chalk & BB/Online Session with PPT
	Weeks 2	OS Service, System Calls, OS structure: Layered, Monolithic, Microkernel Operating Process Management	1,2,3	Chalk & BB/Online Session with PPT
	Week 3	Processes:Definition , Process Relationship , Process states , Process State transitions , Process Control Block ,Context switching ,Threads ,Concept of multithreads , Benefits of threads ,Types of threads Process Scheduling:Definition , Scheduling objectives ,Types of Schedulers ,	1,2,3,4	Chalk & BB/Online Session with PPT
	Week 4	Scheduling criteria : CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time (Definition only) , Scheduling algorithms : Preemptive and Non , pre emptive , FCFS ,SJF ,RR , Multiprocessor scheduling : Types , Performance evaluation of the scheduling.	1,2,3,4	Chalk & BB/Online Session with PPT
	Week 5	Inter-process Communication :Race Conditions, Critical Section, Mutual Exclusion, Hardware Solution,	1,2,3,4,11,12	Chalk & BB/Online Session with PPT
	Week 6	Strict Alternation , Peterson's Solution, The Producer Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc., Scheduling , Scheduling	1,2,3,4,11,12	Chalk & BB/Online Session with PPT

		Algorithms.		
	Week 7	Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc., Scheduling , Scheduling Algorithms.	1,2,3,4,11,12	Chalk & BB/Online Session with PPT
	Week 8	Memory Management Basic Memory Management:Definition ,Logical and Physical address map , Memory allocation : Contiguous Memory allocation –Fixed and variable partition –Internal and External fragmentation and Compaction , Paging : Principle of operation –Page allocation –Hardware support for paging – Protection and sharing – Disadvantages of paging.	1,2,3,4,5	Chalk & BB/Online Session with PPT
	Week 9	Virtual Memory: Basics of Virtual Memory –Hardware and control structures –Locality of reference, Page fault , Working Set , Dirty page/Dirty bit –Demand paging –Page Replacement policies : Optimal (OPT) , First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU)	1,2,3,4,5,11,12	Chalk & BB/Online Session with PPT
	Week 10	I/O Management Principles of I/O Hardware: I/O devices, Device controllers , Direct memory access Principles of I/O Software: Goals of Interrupt handlers , Device drivers , Device independent I/O software , Secondary-Storage Structure: Disk structure ,Disk scheduling algorithm	1,2,3,4,11,12	Chalk & BB/Online Session with PPT
	Week 11	File Management File concept, Aaccess methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous,linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash	1,2,3,4,11,12	Chalk & BB/Online Session with PPT

		table),efficiency & performance		
	Week 12	Security & Protection Security Environment, Design Principles Of Security, User Authentication, Protection Mechanism : Protection Domain, Access Control List Unix/Linux Operating System Development Of Unix/Linux, Role & Function Of Kernel, System Calls, Elementary Linux command & Shell Programming, Directory Structure, System Administration	1,2,3,4,11,12	Chalk & BB/Online Session with PPT

PROGRAM MAP for Bachelor of Engineering

COMPUTER ENGINEERING DEPARTMENT COURSE DEPENDANCY CHART