GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Computer Engineering / Computer Science & Engineering

Course / Subject Code : DI03000041

Course / Subject Name : Fundamentals Operating System

W.E. F. Academic Year:	2024-25
Semester:	3nd
Category of the Course:	PCC

Prerequisite:	Basic computer literacy, Logical Thinking and Command Line Interface
Rationale:	As a core subject of Computer Engineering, this course enables to understand importance of Operating System, its functionalities to manage resources of Computer and Peripherals, program development and its execution. An operating system (OS) is the core software that manages hardware resources and provides essential services to applications. Every student of computer science must therefore understand basic structure of an operating system. After learning this subject student will be able to discriminate between various types of operating systems, its processor, processes, and memory and file management. The subject also emphasizes on Linux utilities and scripting.

Course Outcome:
After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Differentiate operating systems based on their features.	Understanding
02	Apply process scheduling algorithms to calculate turnaround time and average waiting time.	Apply
03	Interpret various memory management techniques.	Understanding
04	Interpret various file& directory management techniques.	Understanding
05	Execute basic Linux commands and Shell scripts.	Apply

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA(M)	PA(I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Introduction of Operating System Fundamental Goals of Operating system, Operating System services Types of Operating Systems: Multi programming, Time sharing, Real Time, Multithreading, Distributed, Embedded Operating System OS structure: Layered, Monolithic, Microkernel Operating Systems Case Study: Linux, Latest Windows Operating System, Mac OS	06	13
2	Concepts of Process Overview of the Process & threads, Process Life Cycle/ Process States, Process Control Block (PCB) Process Scheduling Scheduling Criteria, Scheduling Algorithms: First Come First Serve, Shortest Job First, Round Robin, Non-Preemptive Priority based Scheduling	14	31

2.	Overview of Schedulers Tyes of Schedulers: Long term Schedulers, Short Term Schedulers, Medium Term Schedulers, Scheduling Queues, Context Switch Process Synchronization Critical Section, Mutual Exclusion, Race Condition Deadlock Definition, Conditions for Deadlock, Dealing with Deadlock: ignorance of deadlock, Detection and recovery, Dynamic avoidance, Deadlock Prevention, Resource allocation graph		
3	Memory Management Logical and physical address, Swapping Memory Allocation 1. Contiguous memory allocation: Multiprogramming with Fixed partition, Multiprogramming with dynamic partition, Internal and External Fragmentation and compaction, Memory relocation and protection mechanism, Allocation techniques – First Fit, Best Fit and Worst Fit 2. Non-Contiguous Memory allocation Overview of Paging: Address translation using basic method of paging, Overview of Segmentation: Address translation using Segmentation Page replacement algorithm – FIFO, LRU	10	23

4	Files System Files Attributes, File Operations, File Types, File Paths: Absolute file path, Relative file path, File Security and Protection mechanism Directory System Directory Structures: Single Level, Two Level, Tree Structured, Acyclic Graph, General Graph Directory Structure Disk space Allocation Methods – Contiguous, Linked, Indexed Secondary Storage Structure Physical Structure of Disk Disk Scheduling Algorithm – SCAN, CSCAN	06	13
5	Unix/LinuxOperatingSystem Linux Introduction, Basic architecture of Unix/ Linux Basics of Unix/Linux Programming Introduction to shell and commands Commands: pwd, cd, mkdir, rmdir, ls, cat, cp, rm, mv, wc, split, cmp, comm, diff, head, tail, grep, sort Editing files with “vi”, “vim”, “gedit”, “gcc” Linux Basic shell scripts Read using command line argument Arithmetic Operators, logical operators, Relational operators Evaluate expression using test command Branching: if, if...else, case Basic of Looping: while loop, for loop	09	20
	Total	45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
26	44	30	0	0	0

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom’s Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Abraham Silberschatz, Peter B Galvin, Gerg Gagne "Operating System Concepts, 9th Edition" , WILEY, 2018, ISBN-13 - 978-8126554270
2. Sumitabha Das, "Unix Concepts And Application, 4th Edition", MGH (1 July 2017), ISBN-13 – 978-0070635463
3. Andrew Tanenbaum, Herbert Bos, "Modern Operating System 3rd Edition", 2015,Pearson, ISBN-13 – 9780133591620
4. Milan Milenkovic, "Operating System, 2nd Edition", 2014, MGH, ISBN-13: 978-0-07- 463272-7

(b) Open source software and website:

1. https://www.os-course.eu
2. https://www.linux.org
3. https://process-scheduling-solver.boonsuen.com/
4. http://cpuburst.com/ganttcharts.html
5. https://nptel.ac.in
6. https://www.youtube.com
7. https://www.edx.org
8. https://www.coursera.org/courses?query=operating%20system
9. https://www.udemy.com
10. https://www.onlinegdb.com/online_bash_shell

Suggested Course Practical List:

1) Compare Windows, Linux OS and Mac OS. (latest version)
2) Process Scheduling algorithm
   a) UsingFCFS, SJFandRoundrobinalgorithm, drawGanttchart for Process P0, P1, P2, and P3. Arrival time 0, 1, 2, 3 and process execution Time 5, 3, 8, 6 respectively. Find Average turnaround time and average waiting time.
   b) UsingFCFS, SJFandRoundrobinalgorithm, drawGanttchart for Process P0, P1, P2, and P3. Arrival time 3, 0, 4, 5 and process execution Time 5, 4, 2, 4 respectively. Find Average turnaround time and average waiting time.
3) SolveexamplesusingFirstfit, Best fit, Worst fit Algorithms where Jobs J1 with 20KB , J2 with 200KB , J3 with 500KB, J4 with 50KB, J5 with 150 KB memory requests
   Consider memory partitions of size 50 KB, 300 KB, 75 KB, 700 KB and 100 KB.
4) Solve Using LRU and FIFO. Consider the page reference string of size 12: 1, 2, 3, 4, 5, 1, 3, 1, 6, 3, 2, 3 with frame size 4(i.e. maximum 4 pages in a frame).
5) Consider a disc with 200 tracks (0-199) and a disc queue with the following input/output requests: 75, 90, 40, 135, 50, 170, 65, 10. The Read/Write head's initial position is 46, and it will move to the

left-hand side. Using the SCAN and CSCAN method, determine the total number of track movements of the Read/Write head.

6) Test and run basic Unix commands.
7) Test and run advanced Unix commands.
8) Test commands related with File editing with Vi, Vim, gedit, gcc.
9) Create a shell script to read from command line and print “Hello”.
10) Create a Shell script to read and display content of a file. And append content of one file to another
11) Create a Shell script to accept a string in lower case letters from a user, & convert to upper case letters.
12) Create a Shell script to add two numbers.

List of Laboratory/Learning Resources Required:

1. Computer with basic configuration with windows or unixos
2. Virtual Machines (VMware/VirtualBox) for multi-OS setup
3. Linux Terminal or Shell Scripting Tools

Suggested Project List:

1. A Comparative Analysis of Operating System: case study of Windows Operating and Mac OS. Comparing factors like booting process, user interface, handling system resources, device management, file management, security.
2. A Comparative Analysis of Operating System: case study of Windows Operating and Linux based OS. Comparing factors like booting process, user interface, handling system resources, device management, file management, security.
3. Comparing features of Windows 7, Windows 8 and Windows 10.Also show newly added functionality in each version.
4. Case study on different Disk scheduling algorithms. Describe working of each algorithm.
5. Case study on different Process scheduling algorithms. Describe working of each algorithm.
6. Case Study on different page replacement algorithms. Describe working of each algorithm.
7. Case study on fragmentation in operating system.
8. Animate the Disk scheduling algorithms
9. Animate the Process scheduling algorithms.
10. Animate the Page replacement algorithms.
11. Case study on any one cloud operating system.
12. Case study on any one real time operating system.
13. Case study on any one server operating system.
14. Case study on any one distributed operating system.

15. Case study on any one network operating system.
16. Case study on any one time sharing or multitasking operating system.

Suggested Activities for Students:

a) Students are encouraged to register themselves in various MOOCs such as: Swayam, edx, Coursera, Udemy etc to further enhance their learning.
   https://www.udemy.com/course/operating-systems-from-scratch-part1/
   https://onlinecourses.swayam2.ac.in/ntr25_ed41/preview
   https://www.coursera.org/learn/akamai-operating-systems
   https://onlinecourses.nptel.ac.in/noc21_cs72/preview
   https://onlinecourses.nptel.ac.in/noc24_cs108/preview
b) Perform hands-on practice by installing and using different Operating Systems (Windows, Linux, Ubuntu) on Virtual Machines like VirtualBox or VMware.
c) Explore and practice basic OS commands using the Command Prompt (Windows) and Terminal (Linux) for file management, process control, and system monitoring.
d) Implement CPU Scheduling Algorithms (FCFS, SJF, Round Robin) using C/Python to understand process scheduling concepts.
e) Work on File System Management activities like disk partitioning, file permissions, and access control using chmod, chown, and ls -l.
f) Participate in OS-based hackathons, coding competitions, and open-source projects to gain real-world experience.

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