GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering
Level: UG
Subject Code: BE04000221
Subject Name: Operating Systems

w. e. f. Academic Year:	2024-25
Semester:	4
Category of the Course:	Professional Core Course

Prerequisite:	Knowledge of C Programming , Data Structures and Computer Architecture with assembly programming
Rationale:	Operating System is a core subject of Computer Engineering/Information Technology. The study of Operating Systems provides in-depth understanding of Program Execution Environment and management of various types of hardware and software resources in Computer. It involves important aspects of understanding Security, Virtualization, Storage and Access of Data and Parallelism of Processing.

Course Outcomes:

Sr. No.	CO statement	Marks% weightage
CO-1	Students will be able to understand the underlying components and architecture of the OS.	25
CO-2	Students will be able to conceptualize the executing program – with Process & Thread management.	20
CO-3	Students will be able to learn and simulate existing algorithms and mechanisms for Memory Management.	20
CO-4	Students will be able to analyze and compare File management and I/O Management with different Operating Systems.	20
CO-5	Students will be able to understand Virtualization, Security, Parallelism available in various existing OS and future OS.	15

Teaching and Examination Scheme:

Teaching - Learning Scheme (in Hours per Semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	PBL*	TH		ESE (E)	PA (M)	PA (I)	PBL (I)	ESE (V)	
45	0	30	45	120	04	70	30	20	30	50	200

- **Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.**

Content:

Sr. No.	Content	Total Hrs
1	**Introduction:** Computer system overview, Architecture, Goals & Structures of O.S, Basic functions, Interaction of O.S. & hardware architecture, System calls, Batch, multiprogramming. Multitasking, time sharing, parallel, distributed & real-time O.S.	04
2	**Process and Threads Management:** Process Concept, Process states, Process control, Threads, Uni-processor Scheduling: Types of scheduling: Preemptive, Non preemptive, Scheduling algorithms: FCFS, SJF, RR, Priority, Thread Scheduling, Real Time Scheduling. System calls like ps, fork, join, exec family, wait.	05
3	**Concurrency & Synchronization:** Principles of Concurrency, Mutual Exclusion: S/W approaches, H/W Support, Semaphores, Pipes, Message Passing, Signals, and Monitors.	05
4	**Inter Process Communication:** Race Conditions, Critical Section, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dining Philosopher Problem etc., Scheduling concept and Scheduling Algorithms.	06
5	**Deadlock:** Principles of Deadlock, Starvation, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, System calls.	03
6	**Memory Management:** Memory Management requirements, Memory partitioning: Fixed and Variable Partitioning, Memory Allocation: Allocation Strategies (First Fit, Best Fit, and Worst Fit), Swapping, Paging and Fragmentation. Demand Paging, Security Issues. **Virtual Memory:** Concepts, VM management, Page Replacement Policies (FIFO, LRU, Optimal, Other Strategies), Thrashing.	07
7	**I/O Management & Disk scheduling:** I/O Devices, Organization of I/O functions, Operating System Design issues, I/O Buffering, Disk Scheduling (FCFS, SCAN, C-SCAN, SSTF), RAID, Disk Cache.	05
8	**Unix/Linux Operating System:** Development Of Unix/Linux, Role & Function Of Kernel, System Calls, Elementary Linux command & Shell Programming, Directory Structure, System Administration	05

	Case study: Linux, Windows Operating System	
9	**Virtualization Concepts:** Virtual machines; supporting multiple operating systems simultaneously on a single hardware platform; running one operating system on top of another. True or pure virtualization. **Approaches to Virtualization:** Processor Issue, Memory Management, I/O Management, VMware ESXi, Microsoft Hyper-V and Xen Variants, Java VM, Linux VServer Virtual MachineArchitecture, Android Virtual Machine.	**05**
	TOTAL	**45**

Suggested Specification table with Marks (Theory): (For B.E. only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
25	**25**	**20**	**10**	**10**	**10**

R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Modern Operating Systems by Andrew S Tanenbaum, Prentice Hall India.
2. Operating System Concepts by Silberschatz, Peter B. Galvin and Greg Gagne, Wiley-Indian Edition.
3. Principles of Operating Systems by Naresh chauhan, Oxford Press.
4. Operating Systems by D.M. Dhamdhere, Tata McGraw Hill.
5. Operating Systems – Internals and Design Principles by William Stallings, Prentice Hall India.
6. UNIX Concepts and Applications – by Sumitabha Das, Tata McGraw Hill.
7. Unix Shell Programming – by Yashwant Kanetkar, BPB publications.

- **List of Experiments:**

Sr. No.	**Title of Practical**
	Practical 1

1.1	Introduction & Study of various features of O.S.
1.2	Study of basic Linux commands.
1.3	Study of Advance commands and filters of Linux/UNIX.
	Practical 2
2.1	Study of Shell with its environment, Scripting & Features.
2.2	Write a shell script to find the sum & factorial of a given number.
2.3	Write a shell script to find if a given number is prime or not?
	Practical 3
3.1	Write a shell script to find if the given string is Palindrom or not?
3.2	Write a shell script to make a sum of digits of a given number.
3.3	Write a shell script to read n numbers as command arguments and sort them in descending order.
	Practical 4
4.1	Write a C program to create exactly 'n' child processes with use of fork() system call in Linux.
4.2	Write a C program to distribute logic/work among 'n' child processes created by fork() system call in Linux.
4.3	Write a C Program to create two child processes and run 'who' and 'ls' command in it with use of fork() and exec() system call.
	Practical 5
5.1	Write a C Program to create two threads for addition and subtraction of two large size array in parallel.
5.2	Write a C Program to create child processes for addition and subtraction of two large size array in parallel. Compare the parallelism achieved by Thread model and child Process model.
	Practical 6
6.1	Write a C programs to demonstrate the use of shared memory variables.
6.2	Write a C program to demonstrate and use of semaphores in Linux.
	Practical 7
7.1	Write a shell script to find max, min , average of given set of numbers.
7.2	Write a shell script to complete CD command which take one number as argument and moves that many levels up from the current directory.
	Practical 8
8.1	Write a shell script to mail a common message to all users who are currently logged in.

8.2	Write a shell script to display 5 largest files in the current directory.
8.3	Write a shell script to count how many files in a given directory.
	Practical 9
9.1	Write a C program to implement "ls" command in Linux.
9.2	Write a C program to implement "who" command in Linux.
	Practical 10
10.1	Write a shell script to translate all characters in File to upper case.
10.2	Write a shell script to change file extension (.txt) to (.doc) using for loop.
10.3	Write a shell script to compare two files to check whether they are same or not.

Major Equipment:

List of Open Source Software/learning website:

1. **www.nptel.ac.in**
2. **https://www.tutorialspoint.com/**
3. **https://www.udemy.com/**
4. **https://www.coursera.org/**
5. **https://www.cse.iitb.ac.in/~mythili/teaching/cs347_autumn2016/index.html**

- **List of suggested activities for Problem Based Learning:**

Sl. No.	Name of the activity	No. of hours	Evaluation Criteria
1	Assignment writing. Numerical based assignment is preferable.	5 assignments of 3h each. Total = 15h	Based on the assignment submitted.
2	Problem solving/Coding using C, C++, Python, SCILAB, MATLAB, MS-EXCEL or any other relevant software	5 small coding-based problems of 3h each. Total = 15h	Based on the coding solution submitted.
3	Technical Video based learning related to the subject	Duration of video = 5h Report preparation & Presentation = 10h Total = 15h	Report /presentation based on the video learning outcomes.
4	Discussion on research paper based on relevant subject	3 research paper = 15h	Summarize research paper and evaluation critical parameters

5	Poster/chart/power point preparation on technical topics	Duration = 10 h	Based on poster/chart preparation and presentation skills
6	Application/Software development	Duration = 15 h	Depending on the complexity of the Application/Software
7	Group Discussion on emerging/trending technical topics based on subject	Duration = 1 h each	Based on performance in group discussion, technical depth, knowledge etc.
8	Seminar / Presentation	Duration for study and preparation=5h Report writing=3h Presentation=2h Total=10h	Topic can be selected technical content beyond syllabus
9	Real world case studies-based learning	Duration of data collection/study = 5h Report preparation = 10h Total = 15h	Based on in-depth study, technical depth, data collected, fact finding, etc.
10	Working/non-working model on technical topics	Working = 12 h Non- working = 8 h	Based on inter department/external evaluation
11	Self-learning on-line course	Minimum duration of the course should be 15h.	Examination based assessment at the end of course. Based on the certificate produced.
12	Complex problem solving	Maximum 3 problem. Study of the problem and solution finding, Total = 15h	Based on the depth of the solution submitted.
13	Industry/Research laboratory visit	Visit = 5h, Report preparation = 5h Total = 10h	Based on report submitted. Report should contain observations and calculations based on industry/ lab data.
14	Videos on Industrial safety aspects based on subject	Duration of video = 5h Report preparation = 5h Total = 10h	Based on quiz/report submitted
15	Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment /health/any other issue	Duration = 15 h for industrial exposure Problem identification and tentative solution = 10 h Total = 20 h	Based on evaluation of critical problems and solutions

Note:

- All the suggested activity should be related to the subject.
- Min 3 activities must be carried out as per the availability of faculties and students.
- The number of hours is suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
- Rubrics for the evaluation can be prepared by the faculty.

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