GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Information & Communication Technology

Course / Subject Code : DI03032011

Course / Subject Name : System Administration & Practices

w. e. f. Academic Year:	2024-25
Semester:	3rd
Category of the Course:	ESC

Prerequisite:	Basic understanding of computer hardware and software.
Rationale:	The "System Administration & Practice" course is designed to equip diploma-level students in their third semester with essential skills for managing and maintaining computer systems effectively, preparing them for entry-level IT roles. By focusing on operating system installation, user management, disk and resource administration, security implementation, backup strategies, and automation through scripting, the course addresses the core responsibilities of a system administrator. This curriculum builds on prior foundational IT knowledge, ensuring students develop the technical proficiency and skills needed to support system software & hardware.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Install OS and understand role of system administrator.	R,U,A
02	Manage users and groups, including creation, modification, deletion, permissions, and password policies.	R,U,A
03	Monitor and control system processes, managing services, and analyzing performance.	R,U,A
04	Write and execute basic shell scripts using variables, control structures, and cron scheduling to automate administrative tasks.	R,U,A
05	Perform disk management, file system maintenance, and backup/recovery techniques using various commands.	R,U,A

**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)	
0	1	4	3	0	0	20	30	50

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Introduction to Linux System Administration** 1.1 Overview of Linux Systems: Introduction to Operating system History and distributions of Linux, Differences Between Windows and Linux, Role of a system administrator 1.2 Linux File System Basics: File system hierarchy (FHS), Navigating directories and file permissions 1.3 Basic Commands and Tools: Essential shell commands (ls, cd, pwd, cat, etc.), Using man pages and help systems	22	
2.	**User and Group Management** 2.1 Managing Users: Creating, modifying, and deleting users, Password management and policies (commands- useradd, usermod, userdel, passwd, chage, id etc) 2.2 Managing Groups: Group creation and membership, Assigning privileges to groups (commands- groupadd, groupmod, groupdel, gpasswd, groups, usermod -aG etc) 2.3 File Permissions and Ownership: Understanding chmod, chown, and chgrp, Special permissions (chmod, chown, chgrp, ls -l, find etc)	8	
3.	**Process and Service Management** 3.1 Process Management : Viewing and controlling processes, Background and foreground processes(ps, top, kill, bg, fg, jobs etc.)	18	

	3.2 System Services: Introduction to system, Starting, stopping, and enabling services (systemctl, service, chkconfig (legacy systems) etc.) 3.1 Monitoring System Performance : Tools like top, htop, and free Log file analysis (top, htop, free, vmstat, cat (for logs, e.g., cat /var/log/syslog), tail (e.g., tail /var/log/syslog), less (e.g., less /var/log/messages))		
4.	**Shell Scripting Basics** 4.1 Introduction to Shell Scripting: What is a shell script? Bash basics Writing and executing a simple script 4.2 Variables and Control Structures: Defining variables and user input, If-else statements and loops (for, while) 4.3 Automating Administrative Tasks: Scripting file backups and user management, Scheduling scripts with cron	12	
5.	**Storage and File System Management** 5.1 Disk Management: Partitioning and formatting disks (fdisk, mkfs), Mounting and unmounting file systems (mount, umount) 5.2 File System Maintenance: Checking and repairing file systems Managing disk quotas (fsck, quota, quotacheck, edquota, setquota) 5.3 Backup and Recovery: Using tar and cp for backups, Restoring files from backups	15	
	Total	**75**	**100**

Suggested Specification Table with Marks (Theory): NA

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
-	-	-	-	-	-

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:

Sr. No	Title of the book	Author	Publication
1	Linux Administration: A Beginner's Guide	Wale Soyinka	McGraw hill ISBN: 978-0-07-176759-0
2	Practical Linux System Administration	Kenneth Hess	O'Reilly ISBN: 978-1-098-10903-5
3	UNIX and Linux System Administration Handbook	Evi Nemeth et al	Addison Wesley ISBN: 978-0-13-427755-4
4	Linux Shell Scripting Cookbook	Shantanu Tushar, Sarath Lakshman	PACKT Publishing ISBN 978-1-78216-274-2
5	Shell Scripting: Expert Recipes for Linux, Bash, and More	Steve Parker	John Wiley & Sons ISBN: 978-0-470-02448-5

(b) Open source software and website:

1. https://labex.io/tutorials/linux-online-linux-playground-372915
2. https://www.redhat.com/en/services/training/rh124-red-hat-system-administration-i
3. https://nptel.ac.in/courses/106105214
4. https://nptel.ac.in/courses/117106113
5. https://www.edx.org/learn/linux/ibm-introduction-to-linux-system-administration-with-ibm-power-systems

Suggested Course Practical List:

The following practical outcomes (PrOs) are the subcomponents of the COs. These PrOs need to be attained to achieve the COs.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Install Linux operating system and compare with Window OS.	I	4
2	Execute general-purpose commands on Linux (date, time, cal, clear, banner, tty, script, man.) and equivalent Windows commands (e.g., date, time, cls, whoami, systeminfo).	I	4
3	Study the responsibilities of a system administrator conceptually.	I	2

4	Navigate and explain the purpose of key FHS directories.	I	2
5	Practice directory navigation and basic permission management.	I	2
6	Execute and understand basic shell commands for file manipulation.	I	2
7	To access and interpret command documentation.	I	2
8	Create and customize user accounts with specific attributes in Linux, configure and verify password aging and security policies, remove a user account and associated data safely.	II	2
9	Create a group and manage user membership within it, alter group properties and remove groups as needed.	II	2
10	Modify file permissions and ownership for access control in Linux. Configure Windows file permissions using GUI and icacls command.	II	2
11	Implement SUID, SGID, and sticky bit for advanced access scenarios.	III	2
12	Monitor and terminate processes using system tools in Linux and Windows.	III	2
13	Control process execution states (background/foreground).	III	2
14	Start, stop, and enable system services in Linux and Windows OS.	III	4
16	Assess system performance using resource monitoring tools.	III	2
17	Interpret system logs for troubleshooting and monitoring.	III	2
18	Create and run a basic shell script to automate a task.	IV	2
19	Use variables and user input in a script for dynamic behavior.	IV	2
20	Apply conditional statements and loops for script logic.	IV	2
21	Automate a file backup process using a shell script.	IV	2
22	Schedule a script to run automatically using cron.	IV	2
23	Partition and format a disk for use in a Linux system.	V	2
24	Mount and unmount a file system to manage storage access.	V	2
25	Verify and repair file system integrity using diagnostic tools.	V	2
26	Configure disk quotas to limit user storage usage.	V	2
27	Perform a file backup using archiving and copying tools.	V	2
28	Restore files from a backup to recover data.	V	2
	Total		**60**

List of Laboratory/Learning Resources Required:

1. Hardware Requirements:
   Computer Systems: Minimum 4GB RAM, multi-core processor
   Virtualization Support: VirtualBox / VMware for running Linux environments
   External Storage: USB drive or external HDD for backup and recovery exercises

2. Software Requirements:
   Linux Distributions: Ubuntu, CentOS, Debian, Fedora, or any preferred Linux distro
   Oracle VirtualBox
   Terminal Emulator: Default Linux terminal, PuTTY (for remote access), or Terminator
   Shell Environment: Bash shell (default on most Linux distributions)

Suggested Project List:

1. User and Group Management Script – Automate user creation, deletion, and group assignment.
2. Linux File Permissions Analyzer – Create a script to check and modify file permissions.
3. Process Monitoring Tool – Develop a script using ps and top to monitor system processes.
4. Automated Log File Analyzer – Script to filter and analyze system logs (/var/log/syslog).
5. Shell Script for System Backup – Automate file system backup using tar and rsync.
6. Disk Usage Monitoring Script – Alert when disk usage exceeds a threshold.
7. Automated Software Installation Script – Script to install and configure essential packages.
8. Scheduled System Maintenance Script – Automate cleanup tasks using cron.
9. Linux Service Manager – Script to start, stop, and check the status of services.
10. User Login Tracker – Monitor user login activity and failed login attempts.
11. Simple Firewall Configuration Tool – Script to configure iptables or ufw.
12. Automated System Update Script – Schedule system updates using apt or yum.
13. Partition and Mount Management Script – Automate partition creation and mounting.
14. File Encryption and Decryption Tool – Use gpg for encrypting and decrypting files.
15. System Performance Dashboard – Use htop and free to display system performance metrics.
16. Linux User Privilege Manager – Manage sudo permissions for different users.
17. Automated System Resource Report – Generate a report on CPU, RAM, and disk usage.
18. Log Rotation and Archiving Script – Manage log files to prevent system overload.

Suggested Activities for Students:

1. Compare Linux vs. Windows OS Features – Create a comparison table highlighting key differences.
2. Identify Linux Distributions – Research and present the major Linux distributions and their use cases.
3. System Installation Walkthrough – Document the steps for installing a Linux OS.
4. Command Cheat Sheet Creation – Compile a reference sheet for common Linux commands and their Windows equivalents.
5. File System Hierarchy Exploration – Prepare a visual representation of the Linux FHS structure.
6. User and Group Management Case Study – Simulate a real-world scenario where user access control is essential.
7. Shell Command Challenge – Conduct a timed challenge where students execute specific commands.
8. Real-World System Admin Interview – Invite a system administrator for a Q&A session.
9. Permission Troubleshooting Activity – Identify and fix incorrect file permissions in a given scenario.
10. Process Management Scenario – Analyze and optimize running processes on a Linux system.
11. Service Management Simulation – Configure and troubleshoot system services in different states.
12. System Performance Analysis Task – Record system performance metrics and discuss optimization strategies.
13. Log File Investigation Exercise – Analyze system logs to identify common issues.
14. Shell Scripting Mini-Project – Automate a daily task using a shell script.
15. Backup and Recovery Drill – Simulate a system failure and restore files from a backup.
16. Disk Partitioning Hands-on – Create, format, and mount a new partition on a Linux system.
17. Cron Job Scheduling Experiment – Automate a task using cron and document the process.
18. Security Enhancement Task – Implement security measures like file permissions and access control.
19. Network Configuration Task – Set up a basic Linux network and test connectivity.
20. Final System Administration Challenge – Apply all learned skills to troubleshoot a misconfigured Linux system.

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