A. Course Handout(Version 1.0)

Institute/School Name	Chitkara University Institute of Engineering and Technology		
Department Name	Department of Computer Science & Engineering		
Programme Name	Bachelor of Engineering (B.E.), Computer Science & Engineering		
Course Name	Linux Administration	Session	2024-2025
Course Code	22CS009	Semester/Batch	4th/2023
L-T-P(Per Week)	2-0-2	Course Credits	03
Pre-requisite	Introduction to Operating System, Programming concepts, terminal commands	NHEQF Level	05
Course Coordinator	Dr. Jatin Arora	SDG Number	04,05,09,10,16

CLO01	Understand fundamental concepts of Linux operating system.
CLO02	Apply concepts of Linux operating system in order to solve the real-life problems.
CLO03	Analyze the processes, file system and system directories in Linux operating system.
CLO04	Understand the working of Linux based system to manage the user or group of users in a network.
CLO05	Construct solutions for engineering problems by using shell script programming in Linux.

1. Objectives of the Course

Linux System Administration course is designed to help the student to become a Linux Admin Expert. The course is designed to shape the student as a Linux professional & help run applications, perform desired functions on system and networks, create a network configuration, and maintain security administration. The course provides a wide scope of learning and understanding of the subject. The objectives of the course are:

- To use Linux operating system knowledge for solving real world problem statements.
- To get familiar with the design, architecture and installation of Linux OS.
- To understand concepts of booting process, File system, working with files and directories, Editors and Filters/ Text processing commands of Linux OS.
- To understand basic concepts to manage the user, group of user's accounts on a system or on a network.
- To get familiar with shell scripting or program Linux system.

2. Course Learning Outcomes

After completion of the course, student should be able to:

Sr. No	Course Outcome	*POs	**CL	***KC	Sessions
CLO01	Understand fundamental concepts of Linux operating system.	PO1,PO2,PO4,PO5, PO9,PO12	K2	Factual Conceptual	16
CLO02	Apply concepts of Linux operating system in order to solve the real-life problems.	PO1,PO2,PO4,PO5, PO12	K3	Conceptual Procedural	20

CLO03	Analyze the processes, file system and system directories in Linux operating system.	PO1,PO3,PO 4,PO5, PO11,PO12	K4	Conceptual Procedural	14
CLO04	Understand the working of Linux based system to manage the user or group of users in a network.	PO1,PO3,PO 5, PO10,PO11	K3	Procedural	16
CLO05	Construct solutions for engineering problems by using shell script programming in Linux.	PO2,PO4,PO 9, PO10,PO11	K4	Procedural	14
Total Contact Hours					80

Revised Bloom's Taxonomy Terminology

* PO's available at

**Cognitive Level =CL

***Knowledge Categories = KC

CLO-PO mapping grid |Program outcomes (POs) are available as a part of Academic Program Guide (APG)

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

H=High, M=Medium, L=Low

3. ERISE Grid Mapping

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

4. Recommended Books:

Text Books:

B01: Linux the Complete Reference, John Purcell, 7th edition, Walnut Creek, 1999.

B02: Linux Command Line and Shell Scripting Bible, Richard Blum, 4rd edition, Wiley, 2021.

B03: Your Unix - The Ultimate Guide, Sumitabha Das, 4th Edition, Tata McGraw-Hill, 2008.

B04: Linux Programming Bible, John Goerzen, 8th Edition, IDG Books, 2001.

B05: A Practical Guide to Linux, Mark G. Sobell, 3rd Edition by Pearson Education, 2013.

B06: Unix Shell programming, Yashwant Kanetkar, 1st Edition, BPB Publications, 2004.

B07: Kubernetes - An Enterprise Guide, Scott Surovich, Marc Boorshtein 3rd Edition, Packt Publishing, 2020.

E-Resources:

- www.redhat.com/academy

5. Other readings and relevant websites:

S. No.	Link of Journals, Magazines, websites and Research Papers
1.	https://www.techtarget.com/searchdatacenter/definition/Linux-operating-system
2.	https://www.geeksforgeeks.org/introduction-to-linux-operating-system/
3.	https://resources.infosecinstitute.com/topic/installing-configuring-centos-7-virtualbox/
4.	https://ubuntu.com/tutorials/install-ubuntu-server#1-overview
5.	https://techlog360.com/basic-ubuntu-commands-terminal-shortcuts-linux-beginner/
6.	https://www.redhat.com/sysadmin/vim-commands
7.	https://learning.edx.org/course/course-v1:LinuxFoundationX+LFS101x+1T2017/home
8.	https://onlinecourses.swayam2.ac.in/aic20_sp24/course
9.	https://www.redhat.com/sysadmin/linux-command-basics-7-commands-process-management
10.	https://www.tutorialspoint.com/unix/unix-file-system.htm

6. Recommended Tools and Platforms

Oracle Virtual Box
Ubuntu Operating System

7. Course Plan:

Lecture Number	Topics	Recommended Book / Other reading material
1-2	Introduction to Linux: History and evolution of Linux, Differences between Linux distributions (Ubuntu flavors, Debian-based vs. others), Overview of Ubuntu and its derivatives (Ubuntu Desktop, Ubuntu Server, Kubuntu, Xubuntu, etc.)	B01, B02
3-4	Installation and Configuration: Preparing for installation (hardware requirements, partitioning with Gparted), Installing Ubuntu (Ubuntu Desktop and Server), Initial system setup (users, passwords, timezone, and basic configuration)	B01, B02
5-6	Basic Command Line Skills: Introduction to the terminal and shell (bash shell in Ubuntu), Navigating the file system (ls, cd, pwd, and Ubuntu directory structure), File and directory manipulation (cp, mv, rm, mkdir, rmdir)	B01, B03
7-8	Basic Command Line Skills: Viewing and editing files (cat, less, head, tail, nano, vim), File permissions and ownership (chmod, chown), Basic process management (ps, top, kill)	RB2,RB3
9	Package Management: Understanding package managers (APT on Ubuntu), Installing, updating, and removing software (apt, dpkg)	B02, B04
ST-1 (Lecture 1-9)		

10	Basic Networking: Understanding IP addresses, DNS, and hostname, Basic network commands (ip, ping, netstat, traceroute), Configuring network interfaces (netplan, nmcli)	B01, B03
11-12	User and Group Management: Creating and managing users and groups (adduser, deluser, groupadd, usermod)	B01, B04
13-14	Configuring user permissions and access (chown, chmod), Understanding /etc/passwd and /etc/group files	B04, B05
15-16	Shell Scripting Basics: Writing and executing simple shell scripts, Understanding variables, loops, and conditionals, Basic input/output redirection and piping (|, >, >>, <)	B05, B06
17-18	File Systems and Disk Management: Understanding file systems (ext4, xfs), Mounting and unmounting file systems (mount, umount), Disk partitioning and management tools (fdisk, parted, df, du)	B04, B05
ST-2 (Lecture 1-18)		
19-20	Advanced File System Management: Understanding and managing file systems (LVM on Ubuntu), Backup and restore procedures (using rsync, tar), File system troubleshooting (fsck, dmesg)	B01
21-22	Advanced Networking: Network configuration and management (netplan, nmcli), Firewall basics (ufw on Ubuntu), Network troubleshooting tools (tcpdump, wireshark)	B01
23-24	System Monitoring and Performance Tuning: System monitoring tools (top, htop, iostat, vmstat), Performance tuning techniques (sysctl, tuned), Log management and analysis (syslog, journalctl)	B01, B03
25-26	Security Basics: Understanding Linux security principles, Managing firewalls (ufw), Implementing SSH and secure remote access (ssh, fail2ban), Security best practices	B02
27-28	Advanced Shell Scripting & System Administration: Advanced shell scripting techniques (functions, advanced string manipulation), Scripting best practices and task automation (cron, at, systemd services), Configuring and managing system services (systemctl)	B01
29-30	Virtualization, Containers, and Advanced Security: Introduction to virtualization (KVM on Ubuntu), Working with containers (Docker, LXC/LXD on Ubuntu), Container orchestration basics (using microk8s for Kubernetes), Advanced firewall and security configurations (ufw, AppArmor on Ubuntu)	B07
ST-3 (Lecture 1-30)		

8. Delivery/Instructional Resources

Lecture Number	Topics	Web References	Audio-Video
1-2	Introduction to Linux: History and evolution of Linux , Differences between Linux distributions (Ubuntu flavors, Debian-based vs. others), Overview of Ubuntu and its derivatives (Ubuntu	https://www.redhat.com/en/topics/linux/what-is-linux	https://www.techtarget.com/searchdatacenter/definition/Linux-operating-system

	Desktop, Ubuntu Server, Kubuntu, Xubuntu, etc.)		
3-4	Installation and Configuration: Preparing for installation (hardware requirements, partitioning with Gparted), Installing Ubuntu (Ubuntu Desktop and Server), Initial system setup (users, passwords, timezone, and basic configuration)	https://ubuntu.com/tutorials/how-to-run-ubuntu-desktop-on-a-virtual-machine-using-virtualbox#1-overview	https://www.youtube.com/watch?v=wSVA-VOwKgE
5-6	Basic Command Line Skills: Introduction to the terminal and shell (bash shell in Ubuntu), Navigating the file system (ls, cd, pwd, and Ubuntu directory structure), File and directory manipulation (cp, mv, rm, mkdir, rmdir)	https://www.edureka.co/blog/linux-commands/	https://onlinecourses.swayam2.ac.in/aic20_sp24/announcements?force=true
7-8	Basic Command Line Skills: Viewing and editing files (cat, less, head, tail, nano, vim), File permissions and ownership (chmod, chown), Basic process management (ps, top, kill)	https://www.tutorialspoint.com/top-5-best-linux-text-editors	https://ru.coursera.org/lecture/linux-fundamentals/editing-text-files-xkv0S
9	Package Management: Understanding package managers (APT on Ubuntu), Installing, updating, and removing software (apt, dpkg)	https://ubuntu.com/server/docs/package-management	https://www.youtube.com/watch?v=yxc2ntmH9xY
10	Basic Networking: Understanding IP addresses, DNS, and hostname, Basic network commands (ip, ping, netstat, traceroute), Configuring network interfaces (netplan, nmcli)	https://learning.edx.org/course/course-v1:LinuxFoundationX+LFS101x+1T2017/home	https://onlinecourses.swayam2.ac.in/aic20_sp24/course
11-12	User and Group Management: Creating and managing users and groups (adduser, deluser, groupadd, usermod)	https://docs.fedoraproject.org/en-US/fedora/latest/system-administrators-guide/basic-system-configuration/Managing_Users_and_Groups/	https://www.youtube.com/watch?v=FtwRe8w2kWI
13-14	Configuring user permissions and access (chown, chmod), Understanding /etc/passwd and /etc/group files	https://learning.edx.org/course/course-v1:LinuxFoundationX+LFS101x+1T2017/home	https://onlinecourses.swayam2.ac.in/aic20_sp24/course
15-16	Shell Scripting Basics: Writing and executing simple shell scripts, Understanding variables, loops, and conditionals, Basic input/output redirection and piping (|, >, >>, <)	https://linuxhint.com/30_bash_script_examples/	https://linuxhint.com/30_bash_script_examples/
17-18	File Systems and Disk Management: Understanding file systems (ext4, xfs), Mounting and unmounting file systems (mount, umount), Disk partitioning and management tools (fdisk, parted, df, du)	https://help.ubuntu.com/stable/ubuntu-help/disk-partitions.html.en	https://www.youtube.com/watch?v=AQ8u-Kx_MSQ&list=PLbvUFWvKlQnnej_Vu588Eor8nc4ENrA0i

19-20	Advanced File System Management: Understanding and managing file systems (LVM on Ubuntu), Backup and restore procedures (using rsync, tar), File system troubleshooting (fsck, dmesg)	https://www.geeksforgeeks.org/tar-command-linux-examples/	https://onlinecourses.swayam2.ac.in/aic20_sp24/announcements?force=true
21-22	Advanced Networking: Network configuration and management (netplan, nmcli), Firewall basics (ufw on Ubuntu), Network troubleshooting tools (tcpdump, wireshark)	https://learning.edx.org/course/course-v1:LinuxFoundationX+LFS101x+1T2017/home	https://onlinecourses.swayam2.ac.in/aic20_sp24/course
23-24	System Monitoring and Performance Tuning: System monitoring tools (top, htop, iostat, vmstat), Performance tuning techniques (sysctl, tuned), Log management and analysis (syslog, journalctl)	https://www.fosslinux.com/134995/how-to-use-sysctl-for-effective-kernel-tuning-in-ubuntu.htm	https://www.youtube.com/watch?v=Kzpm-rGAXos
25-26	Security Basics: Understanding Linux security principles, Managing firewalls (ufw), Implementing SSH and secure remote access (ssh, fail2ban), Security best practices	https://www.hostinger.in/tutorials/how-to-configure-firewall-on-ubuntu-using-ufw/	https://www.youtube.com/watch?v=XtRXm4FFK7Q
27-28	Advanced Shell Scripting & System Administration: Advanced shell scripting techniques (functions, advanced string manipulation), Scripting best practices and task automation (cron, at, systemd services), Configuring and managing system services (systemctl)	https://tldp.org/LDP/abs/html/ https://manpages.ubuntu.com/manpages/xenial/man1/systemctl.1.html	https://www.youtube.com/watch?v=cQepf9fY6cE&list=PLS1QulWo1RIYmaxcEqw5JhK3b-6rgdWO_
29-30	Virtualization, Containers, and Advanced Security: Introduction to virtualization (KVM on Ubuntu), Working with containers (Docker, LXC/LXD on Ubuntu), Container orchestration basics (using microk8s for Kubernetes), Advanced firewall and security configurations (ufw, AppArmor on Ubuntu)	https://phoenixnap.com/kb/install-kubernetes-on-ubuntu	https://www.youtube.com/watch?v=briu_Ev89sw

9. Lab Plan

Sr. No.	Lab Number	Experiments	Learning Resource
1	**1-2**	Use the touch command to create sets of empty practice files to use during this lab. In each set, replace X with the numbers 1 through 6. Create six files with names of the form songX.mp3, snapX.jpg, filmX.avi. Create three subdirectories for organizing your files, and name the subdirectories friends, family, and work. Use a single command to create all three subdirectories at the same time.	www.redhat.com/academy RH124; RH134
2	**3-4**	View the gedit man page. Use the man -k ext4 command to find the command to tune ext4 file-system parameters. Brace expansion is used to generate discretionary strings of characters. Braces contain a comma-separated list of strings,	www.redhat.com/academy RH124; RH134

		or a sequence expression. The result includes the text that precedes or follows the brace definition.	
3	**5-6**	Use Vim,nano, to edit the editing_final_lab.txt file. Use the lab_file shell variable. Enter the visual mode of Vim. Remove the last seven characters from the first column on the first line. Preserve only the first four characters of the first column.	www.redhat.com /academy RH124; RH134
4	**7-8**	Create the /home/consultants directory. Add write permission to the consultants group. Use the symbolic method for setting the appropriate permissions. Forbid others from accessing files in the /home/consultants directory. Use the octal method for setting the appropriate permissions. Change the default umask for the operator1 user. The new umask prohibits all access for users that are not in their group. Confirm that the umask is changed.	www.redhat.com /academy RH124; RH134
5	**9-10**	Implement ps, top, kill command with their options. Installing, updating, and removing software by apt-get command.	www.redhat.com /academy RH124; RH134
6	**11-12**	Create the operator1 user and confirm that it exists in the system. Set the password for operator1. Create the additional operator2 and operator3 users. Set their passwords as well. Run the usermod -c command to update the comments of the operator1 user account. Remove the operator3 user from the system.	www.redhat.com /academy RH124; RH134
7	**13-14**	Implement chown, chmod command with their options	www.redhat.com /academy RH124; RH134
8	**15-16**	Write shell scripts to print system information. Write shell script to perform basic mathematical calculation. Use redirection operators to store the output of commands.	www.redhat.com /academy RH124; RH134
9	**17-18**	Implement fdisk, parted, df, du with their options.	www.redhat.com /academy RH124; RH134
10	**19-20**	Use rsync, tar and compression commands to store the files efficiently.	www.redhat.com /academy RH124; RH134
11	**21-22**	Use netplan, nmcli commands to configure the networking of system, Configure firewall of the system.	www.redhat.com /academy RH124; RH134
12	**23-24**	Use top, htop, iostat, vmstat to check the system performance. Tune the system by using sysctl, tuned, Execute Log management and analysis by syslog, journalctl	www.redhat.com /academy RH124; RH134
13	**25-26**	Execute SSH command to secure remote access on another computer.	www.redhat.com /academy

			RH124; RH134
14	**27-28**	Run shell script to create functions, advanced string manipulation. Run cron and at command to schedule the future tasks.	www.redhat.com /academy RH124; RH134
15	**29-30**	Create containers to create virtual machine on system	www.redhat.com /academy RH124; RH134

10. Action plan for different types of learners

Slow Learners	Average Learners	Fast Learners
Remedial Classes Doubt Sessions Guided Tutorials Use of audio and visual material	Pre-coded algorithms to illustrate concepts E-notes and E-exercises to read ahead of the pedagogic material	Design solutions for complex problems Coding Competitions, Project

11. Evaluation Scheme & Components:

Evaluation Component	Type of Component	No. of Assessments	Weightage of Component	Mode of Assessment
Component 1	Testpad module progress and completion	-	10%	Online
Component 2	Sessional Test	03*	40%	Online
Component 3	End Term Examinations	01**	50%	Online
Total		**100%**		

* Students will have to appear in all Sessional Tests.
*Makeup Examination will compensate for either ST-1 or ST-2 (Only for genuine cases, based on the Dean's approval).
**As per Academic Guidelines, a minimum of 75% attendance is required to become eligible for appearing in the End Semester Examination.

12. Syllabus of the Course:

S. No.	Topic (s)	No. of Sessions	Weightage %
1	Introduction to Linux: History and evolution of Linux , Differences between Linux distributions (Ubuntu flavors, Debian-based vs. others), Overview of Ubuntu and its derivatives (Ubuntu Desktop, Ubuntu Server, Kubuntu, Xubuntu, etc.). Installation and Configuration: Preparing for installation (hardware requirements, partitioning with Gparted), Installing Ubuntu (Ubuntu Desktop and Server), Initial system setup (users, passwords, timezone, and basic configuration). Basic Command Line Skills: Introduction to the terminal and shell (bash shell in Ubuntu), Navigating the file system (ls, cd, pwd, and Ubuntu directory structure), File and directory manipulation (cp, mv, rm, mkdir, rmdir).	**9**	**30%**

	Basic Command Line Skills: Viewing and editing files (cat, less, head, tail, nano, vim), File permissions and ownership (chmod, chown), Basic process management (ps, top, kill). Package Management: Understanding package managers (APT on Ubuntu), Installing, updating, and removing software (apt, dpkg)		
Sessional Test -1			
2	Basic Networking: Understanding IP addresses, DNS, and hostname, Basic network commands (ip, ping, netstat, traceroute), Configuring network interfaces (netplan, nmcli) User and Group Management: Creating and managing users and groups (adduser, deluser, groupadd, usermod). Configuring user permissions and access (chown, chmod), Understanding /etc/passwd and /etc/group files. Shell Scripting Basics: Writing and executing simple shell scripts, Understanding variables, loops, and conditionals, Basic input/output redirection and piping (|, >, >>, <). File Systems and Disk Management: Understanding file systems (ext4, xfs), Mounting and unmounting file systems (mount, umount), Disk partitioning and management tools (fdisk, parted, df, du)	**18**	**60%**
Sessional Test -2			
3	Advanced File System Management: Understanding and managing file systems (LVM on Ubuntu), Backup and restore procedures (using rsync, tar), File system troubleshooting (fsck, dmesg). Advanced Networking: Network configuration and management (netplan, nmcli), Firewall basics (ufw on Ubuntu), Network troubleshooting tools (tcpdump, wireshark). System Monitoring and Performance Tuning: System monitoring tools (top, htop, iostat, vmstat), Performance tuning techniques (sysctl, tuned), Log management and analysis (syslog, journalctl) "Security Basics: Understanding Linux security principles, Managing firewalls (ufw), Implementing SSH and secure remote access (ssh, fail2ban), Security best practices. Advanced Shell Scripting & System Administration: Advanced shell scripting techniques (functions, advanced string manipulation), Scripting best practices and task automation (cron, at, systemd services), Configuring and managing system services (systemctl) Virtualization, Containers, and Advanced Security: Introduction to virtualization (KVM on Ubuntu), Working with containers (Docker, LXC/LXD on Ubuntu), Container orchestration basics (using microk8s for Kubernetes), Advanced firewall and security configurations (ufw, AppArmor on Ubuntu).	**30**	**100%**
Sessional Test -3			
End Term Examination (ETE)			

This Document is approved by:

Designation	**Name**	**Signature**
Course Coordinator	Dr. Jatin Arora	
Head-Academic Delivery	Dr. Mrinal Paliwal	
Dean	Dr. Rishu Chhabra	
Date	29.11.2024	