

Module Code and Title: ITM302 System Administration
Programme: BE in Information Technology
Credit: 12
Module Tutor: Jeevan Gurung
Module Coordinator: Jeevan Gurung

General objectives:

This module equips students with hands-on skills in server and service administration. They will learn to configure, monitor, and manage these systems effectively while gaining troubleshooting and service operation expertise. The focus is on mastering Linux fundamentals, including file permissions, ownership, system services, and security.

Learning Outcomes:

On completion of the module, students will be able to:

1. Install and configure an Operating System (OS) for a server.
2. Distinguish different file systems: Unix, Linux and Windows
3. Set permissions and ownerships of a file.
4. Configure and implement SELinux security to files and directories.
5. Apply Access Control List (ACL) permission to the file and directory.
6. Perform files and database backup and restore.
7. Install and configure different servers: DHCP, DNS, HTTP/HTTPS, SMTP, FTP, NFS
8. Apply security to DNS and web servers. Apply DNS security, web security, Firewall, and SSH.

Learning and Teaching approach:

Type	Approach	Hours per week	Total credit hours
Contact	Lecture/Flipped classroom	3	90
	Guided Exercise	1	
	Practical	2	
Independent Study	Assignment	1	30
	Self-study	1	
Total			120

Assessment Approach:

Assessment components consist of **Continuous Assessment (CA) Theory - 35%**, **Continuous Assessment (CA) Practical - 35%** and **Semester-End Examination - 30%**. The CA Theory will consist of a Mid-term Test (15%), assignment (10%) and industrial visit (10%). The CA Practical will consist of guided exercise (10%), laboratory work (15%), and laboratory exam (10%).

Assessments will be carried out continuously through the following assessment components:

A. Mid-term Test: (15%)

Students will take a written exam of 1-hour duration covering topics up to 5th week. The exam will be marked out of 15 marks. This will be converted to 15% while computing the total marks for the module.

B. Assignment: (10%)

This is an individual student task in order to determine the student's ability to solve problems related to system administrations and management. For the assignment, students will be provided a total of 10 activities to implement the concepts covered until the 10th week. The assignment questions will be uploaded on the VLE in the 9th week and submitted by the 13th week through the assignment/workshop activity on the VLE. The assignment shall be evaluated with the following criteria (10 marks):

- 2 Cover page and presentation
- 4 Correctness
- 2 Timeliness
- 2 Completeness

The grade will be converted to 10% while computing the total marks for the module.

C. Industrial Visit : (10%)

This will enable students to reflect on how system administration and management tasks are carried out in the industry. All students will have to visit data centres and related organizations for at least a day and a half. Upon completion of the visit, students are required to write reflections on their visit of about 500-800 words individually and submit them on the third day after they arrive at the College. The grade will be converted to 10% while computing the total marks for the module. The report will be peer-reviewed using a workshop activity on VLE with the following criteria (10 marks):

- 2 Brief introduction to the visited data centre/organization (100-150 words)
- 3 Students' feeling for the workplace and tasks (300-350 words)
- 3 Your preparedness toward system administration tasks (50 - 150 words)
- 2 Recommendation for improvement if you were given the role. (50 - 150 words)

D. Guided Exercise: (10%)

Students will be given guided exercises after covering each conceptual part during class hours to prepare for the independent lab work. There will be one guided exercise before students do the lab work. The guided exercise with clear instructions will be given and the tutor will assist students during the session to complete it. The grade will be converted to 10% while computing the total marks for the module. The guided exercise will be evaluated based on the following criteria (10 marks):

- 5 Correctness
- 3 Troubleshooting
- 2 Timely execution during the session

E. Laboratory Work: (15%)

Students will be given Lab exercise every week to implement what they have learnt from the lecture and guided exercise. This will test all learning outcomes partially/fully. The grade will be converted to 15% while computing the total marks for the module. The lab work will be assessed during the session and the following criteria will be used for evaluation (15 marks):

- 8 Correctness/Method/Approach/Process
- 3 Code readability and concise inclusion of lab exercise
- 2 Proper command execution
- 2 Timely completion of lab exercise

F. Laboratory Exam: (10%)

A closed-book exam of 3 hours duration will be conducted in the 14th Week. The test will be marked based on the mark allocated and converted to 10% while computing the total marks for the module.

G. Semester-end Examination: (30%)

The exam will be a closed-book examination for 2 hours duration at the end of the semester. The exam will be marked out of 30 marks and it will assess all the learning outcomes of the module. This will be converted to 30% while computing the total marks for the module.

Overview of the assessment approaches and weighting

Areas of Assessment	Quantity	Weighting (%)
A. Mid-term Test	1	15
B. Assignment	1	10
C. Industrial Visit	1	10
D. Guided Exercise	8	10
E. Laboratory Work	8	15
F. Laboratory Exam	1	10
G. Semester-end Examination	1	30
Total		100

Prerequisites: None

Subject Matter**Unit I: Introduction**

- 1.1 Introduction to Linux, Linux OS Architecture, Introduction to System Administration
- 1.2 Installation of server operating system, working on local console: login, switching between pseudo terminal, booting, rebooting, power off.
- 1.3 Using essential tools: Linux Commands and the CLI, Executing Commands, I/O Redirection, Using Pipes, History, Finding Help, Editing Files with vi/vim.
- 1.4 Linux File System: Working with FSH, Defining FSH, Understanding Mounts.

Unit II: Managing Files from the Command Line

- 2.1 Managing Files: working with wildcards, working with directories, Absolute and Relative Pathnames, Listing Files and Directories, Using Links.
- 2.2 Working with Archives and Compressed Files.
- 2.3 Using Common Text file-related Tools – Working with less, showing file content with cat, displaying lines with head and tail, Filtering with cut, Sorting File Contents and output with sort, Counting Lines, Words, and Characters with wc. Using Regular Expressions, using grep to Analyse Text.

Unit III: Users, Permissions and Security

- 3.1 Managing User Accounts – Users on Linux, working as root, switching users, system and normal accounts, creating users, managing user properties, configuration files for user management defaults, managing passwords.
- 3.2 Managing File Ownership – Displaying ownership, changing user ownership, changing group ownership, understanding default ownership.
- 3.3 Managing Permission: Managing Basic Permission – Understanding Read, Write, and Execute permission, Applying Read, Write and Execute Permission, Managing Advanced Permission and Managing ACL – Understanding ACL, preparing your file system for ACL, Changing and Viewing ACL setting with setfacl and getfacl.
- 3.4 Managing SELinux: SELinux Modes, Changing SELinux Enforcing mode, Controlling SELinux File context, Troubleshooting SELinux.

Unit IV: Managing Processes and Software

- 4.1 Introduction to process management, managing shell jobs – Running jobs in the Foreground and Background, Managing parent-child relation.
- 4.2 Using Common Command-line Tools – Processes and Threads, ps, process signals to kill, killall, and pkill, using top to manage processes.
- 4.3 Managing software packages with RPM – Understanding RPM Filenames, querying RPM Database, querying RPM Package file.
- 4.4 Managing software with YUM – Understand repositories, specify which repositories to use, create your own Repository, using yum, updating packages.

Unit V: Configuring SSH and Networking

- 5.1 Introduction to OpenSSH, SSH, SSH keys and SSH Agent.
- 5.2 SSH Server Configuration – Limiting Root Access, Configuring Alternative Ports, Modifying SELinux to Allow for Port Changes, Limiting User Access, Configuring Key-Based Authentication with Passphrases.
- 5.3 Managing Networking: Describing networking concepts, validating network configuration, configuring networking from command line, editing network configuration files, configuring Host Names and Name Resolution.
- 5.4 Managing Gateway and DHCP server: Configuring gateway, configuring DHCP server, DHCP security.
- 5.5 Managing Network Security: Managing Servers Firewall, Controlling SELinux Port Labelling.

Unit VI: Name Server

- 6.1 Understanding DNS, DNS Hierarchy, DNS Terminology, DNS lookup, Understanding Resource Records (RRs).
- 6.2 Setting up DNS Server: Name server installation, name configuration, zone configuration.
- 6.3 Name Server Security, DNSSEC, Dynamic DNS.
- 6.4 Troubleshooting DNS Issues; Testing Config and Zone files using named-checkconfig, named-checkzone, using dig, using host, and analysing client issues.

Unit VII: Web Server

- 7.1 Overview, installation, system requirement.
- 7.2 Configurations: HTTP, HTTPS, VirtualHost.
- 7.3 Apache SELinux-related settings, configuring write access to Document Root.
- 7.4 Understanding TLS Security and Configuring Apache for using TLS certificates.
- 7.5 Deploying CGI Application.

Unit VIII: Mail Server

- 8.1 Overview, understanding email basics, installation mail daemon, configuration mail parameters, accessing mail server.
- 8.2 SMTP, POP, IMAP, Filters.
- 8.3 Verifying a working email configuration.

Unit IX: File Sharing Services and Other Services

- 9.1 FTP Service: FTP server installation, Configuration FTP Server and Client, Managing FTP services.
- 9.2 NFS Service: NFS versions, NFS server configuration, NFS client configuration, Managing NFS services.

Practical List

- 1. Install and configure Server OS.
- 2. Perform setting up a client-server network.
- 3. Perform creating users and groups
- 4. Implement SSH and SSH Agent
- 5. Implement SELinux security
- 6. Configure networking and firewall services
- 7. Install and configure DNS.
- 8. Configure DNSSEC name server.
- 9. Configure and secure Standard web server and Secure web server with TLS certificates.
- 10. Perform Mail server installation and configuration.
- 11. Perform FTP and NFS server installation and configuration.

Reading List:

Essential Reading

- Collings, T., Walls, K. (2015). Red hat linux networking and system administration (3rd ed.) New Delhi, Wiley India Pvt Ltd.
- Matokek, D., Turnbull, J., & Lieverdink, P. (2017). *Pro Linux System Administration* (2nd ed.) Springer. <https://doi.org/10.1007/978-1-4842-2008-5>.
- Nemeth, E., Synder, G., Hein, T.R., Whaley, B. (2018). UNIX and Linux System Administration Handbook (4th. ed.). New Delhi, India: Pearson Education, Inc.

Additional Reading

- Adelstein, T., & Lubanovic, B. (2007). Linux System Administration. O'Reilly Media.
- Bragg, R., & Hunt, C. (2005). Windows Server 2003 network administration. O'Reilly Media.
- Frisch, Æ. (2002). Essential System Administration: Tools and Techniques for Linux and Unix Administration (3ed. ed.). O'Reilly Media.

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