GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2022 (COGC-2022)
Semester-III

Course Title: Linux Operating System
(Course Code: 4331602)

Diploma programme in which this course is offered	Semester in which offered
Information Technology	Third

1. RATIONALE

An operating system is a program that interacts with the user and the computer hardware and controls the execution of all kinds of programs. This course makes students to understand importance of Operating System and Linux distributions, its functionalities to manage resources, Linux program development and its execution. After learning this course, students will be able to classify various types of operating systems and made aware of process and file management with emphasis given to Linux type of Open Source Operating System and its security features.

2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency:

- **Perform Linux shell scripts for resource management in Operating System.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

a) Differentiate various operating systems & explain Linux Operating System.
b) Illustrate various aspects of process, process scheduling and deadlock management.
c) Understand various file management and file allocation techniques.
d) Justify the need of security and protection mechanism in Operating System.
e) Perform various Linux command and develop shell scripts.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	4	30*	70	25	25	150

(*):Out of 30 marks under the theory CA, 10 marks are for assessment of the presentation to facilitate integration of COs and the remaining 20 marks is the average of the tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends:** **L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** -Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** -End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following Practical Outcomes (PrOs) are the sub-components of the COs. *Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'*.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Install & test different types of Operating System & compare its features.	I	02*
2	Compare following process scheduling algorithm. a) First come first serve b) Round Robin c) SJF and SRTN	II	02*
3	Test and execute Linux process commands: top, ps, kill.	II	02*
4	Test and run basic Linux commands to perform following task: a) Display the calendar for the month in which you born. b) Display the calendar for the year 2030. c) Display the date and time of your system. d) Display the date of your system in mm/dd/yyyy format for e.g. 07/14/2030.	V	02*
5	Test and execute Linux file and directory commands to perform following task: a) Display help for pwd command. b) Write a Linux command to clear your screen. c) Display the history of previously executed command.	III & V	02*
6	Test and execute Linux Super User command to perform following task: a) Display the user id of the currently logged-in user of your system. b) Display host name of your system. c) Write a Linux command to display the history of logins into the system. d) Write a Linux command to display the server name. e) Execute the linux command : who, w ,last	IV & V	04*
7	Test and execute Linux editing file commands to perform following task: a) Write a shell script to (i) create user defined directory (ii) rename it and (iii) remove the directory b) Write a shell script to create a blank file with name "MyCollege.txt" and write at least 10 lines. Display the	III &V	04*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	content of file. c) Write a shell script to read two different file names from the command line and copy the content of first file into second file and display suitable message on standard output. d) Write a shell script to search your name from a file and display suitable message.		
8	Test and execute wc command. a) Write a shell script to accept the string "diploma in information technology" from user in lower case letter and convert it into upper case letter. Display output with suitable user-friendly message. b) Create a Shell script to find numbers of characters, words & lines of a given input file "MyCollege.txt"	III	02
9	Understand and Apply Arithmetic Operators. Write a shell script to perform arithmetic operations: a. Write a shell script to read two numbers from users and perform addition, subtraction, multiplication, division and modulus operation of two numbers and display suitable user friendly message on standard output for each operation. b. Write a shell script to read five numbers from user and find average of five numbers. c. Write a shell script to read radius (R) in cm from user and find area (A) of circle and display suitable user friendly message on standard output.	V	04*
10	Understand and apply control statements Write a shell script to perform given operations: a) Write a shell script to find maximum number among three numbers. b) Write a shell script to find sum and average of N numbers. c) Create a shell script to reverse the digits of a given 5-digit number. (for e.g. , if the no. is 57429 then answer is 92475).	V	04*
			28Hrs.

Note

*More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

*i. The following are some **sample** 'Process' and 'Product' related skills(more may be added/deleted depending on the course)that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency..*

Sr.No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Prepare/Install experimental setup.	20
2	Correctness of executing Linux commands and shell scripts.	20
3	Follow the standard command execution practices.	10
4	Interpret the output and prepare document on time.	15
5	Presentation/Case study/Micro project presentation.	35
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to user in uniformity of practical's in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO.No.
1	Computer with latest hardware configuration, CD/DVD reader/writer/USB drive, Source of Linux OS for Installation.	1
2	Linux or alike Operating System such as Ubuntu, CentOS or any other	3 to 10

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above mentioned COs and PrOs. More could be added to fulfill the development of this course competency.

a) Work as a leader/a team member.
b) Follow ethical practices.
c) Give the presentation to fully understand the topic and listen to others with respect.
d) Understand the security and privacy of hardware & software and practice them while performing practical.

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of Revised Bloom's taxonomy that are formulated for development of the COs and competency. If

required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes(UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit – I Operating System Basics	1a. Describe the types of Operating System. 1b. Explain the importance of Operating System. 1c. Compare different types of operating system. 1d. Recognize various distribution of Linux and its features.	1.1 What is Operating System? 1.2 Need of Operating System 1.3 Types of Operating System 1.4 Comparison between various Operating System 1.5 Linux Operating System 1.5.1. History of Linux 1.5.2 Features of Linux 1.5.3 Architecture of Linux 1.5.3 Components of Linux 1.5.4 Distributions of Linux
Unit – II Process management and Inter process communication	2a. Describe Process Model and Process States. 2b. Compare different schedulers. 2c. Compare various scheduling algorithm based on scheduling criteria. 2d. Explain Inter process communication. 2e. Identify Deadlock condition. 2f. Determine various methods of Deadlock prevention, avoidance and recovery.	2.1 Process and Process management 2.1.1 The Process Model and Process states 2.1.2 Process Control Block 2.2 Process Scheduling 2.2.1 Types of Schedulers 2.2.2 Scheduling Criteria : CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time 2.2.3 Scheduling Algorithm: First Come First Serve, Shortest Job First, Round Robin 2.3 Inter Process Communication 2.3.1 Critical Section 2.3.2 Semaphore 2.3.3 Race condition 2.3.4 Mutual Exclusion 2.4 Deadlock 2.4.1 Deadlock characteristics 2.4.2 Deadlock Prevention 2.4.3 Deadlock Avoidance 2.4.4 Deadlock Detection and Recovery

Unit	Unit Outcomes(UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit– III File management and Linux file structure	3a. Describe the file management concepts. 3b. Differentiate between various file allocation methods. 3c. Illustrate Linux file structure. 3d. Define various Linux file system.	3.1 File management 3.1.1 File Structure 3.1.2 Directory Structures 3.1.3 File Attributes and File Types 3.1.4 File Access Methods 3.1.5 File Allocation Methods (Contiguous, linked, indexed) 3.2 Linux File System 3.2.1 Linux File System Structure 3.2.2 Linux File System Features 3.2.3 Types of Linux File System
Unit–IV Security and Protection	4a. Justify the need of security measures in operating system. 4b. Identify various program threats and system threats in operating system. 4c. Justify the needs of protection mechanism in operating system. 4d. Summarize various protection domains.	4.1 Security in Operating system 4.1.1 Security measures in Operating System 4.1.2 System Authentication 4.1.3 Program threats 4.1.4 System threats 4.1.5 Operating System security policies and procedures 4.2 Protection Mechanism 4.2.1 Need of Protection 4.2.2 Protection Domain, Access Control List
Unit V- Linux commands and shell programming	5a. Install free and open source software/operating system. 5b. Perform basic editor commands in Linux. 5c. Perform super user commands in Linux. 5d. Perform process management commands in Linux. 5e. Perform Linux file and directory commands in Linux. 5f. Execute Shell scripts using Linux commands.	5.1 Installation of Linux Operating System 5.2 Basic commands: calendar, date etc. 5.3 Editing files with “vi”, “vim”, “gedit”, “gcc” 5.4 Linux Super user commands : su, loginname, exit, whoami, hostname, sudo 5.5 Linux Process commands : top, ps, kill 5.6 Linux File and Directory Commands : mkdir, rmdir, dirname, pwd, cd, ls, cat, cp, rm, mv, wc, split, cmp, comm, diff, head, tail, grep 5.7 Shell Scripts 5.7.1 Basic operators 5.7.2 Control and loop statements

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Operating System Basics	6	5	5	0	10
II	Process management and Inter process communication	12	6	10	4	20
III	File management and Linux file structure	8	6	6	0	12
IV	Security and Protection	7	8	6	0	14
V	Linux commands and shell programming	9	2	4	8	14
Total		**42**	**27**	**31**	**12**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

Note*: This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should perform following activities in group and prepare reports of about 5 pages for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews. Following is the list of proposed student activities like:

a) Prepare lab report of Practical.
b) Power Point Presentation.
c) Case study and Report preparation.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) ***'L' in section No. 4*** means different types of teaching methods that is to be employed by teachers to develop the outcomes.
c) About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning for making presentation***, but to be assessed using different assessment methods.
d) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.

e) Concepts should be explained thoroughly in theory sessions and should be implemented in laboratory appropriately along with the problem solving.
f) Concept should be developed by giving problems to students as assignment.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project is group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should **not exceed three**.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the micro project should be about **14-16 (fourteen to sixteen) student engagement hours** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a) Prepare a presentation on “Various Linux distribution” / “Kali Linux” / “Linux security”/ “Mobile Operating System” / “Kali Linux and Ethical Hacking”
b) Prepare a presentation on comparative analysis of various process scheduling algorithms based on their scheduling criteria.
c) Prepare a document of various Linux Networking Commands.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Operating Systems	Dhananjay M. Dhamdhere	MGH, 2017 ISBN 978–0–07–295769–3
2	Modern Operating System 4th Edition	ANDREW S. TANENBAUM HERBERT BOS	Pearson, USA ISBN-10: 0-13-359162-X
3	Operating System Concepts	Silberschatz, Peter B. Galvin And Greg Gagne,	JOHN WILEY & SONS. INC,USA, 2009, ISBN – 978-0-470-12872-5
4	Principles Of Operating Systems	Naresh Chauhan	Oxford University Press, New Delhi, 2014, ISBN : 9780198082873
5	Operating Systems-Internals And Design Principles 7th Edition	William Stallings	Prentice Hall, USA,2015, ISBN-13: 978-0-13-230998-1
6	Linux –Application And Administration	Ashok Kumar Harnal	TMH, 2009, ISBN - 1283188996, 9781283188999

S. No.	Title of Book	Author	Publication with place, year and ISBN
7	Operating System, 2005 Edition	Milan Milenkovic	Mcgraw-Hill Education, 1992, ISBN-13 : 978-0071127110

14. SOFTWARE/LEARNING WEBSITES

a) Operating System concepts:http://nptel.iitm.ac.in/courses/Webcourse-contents/IISc-ANG/Operating%20Systems/New_index1.html
b) https://www.tutorialspoint.com/operating_system/os_overview.htm
c) Linux basics: www.freeos.com/guides/lsst
d) Linux basics: www.linuxcommand.org/writing_asell_scripts.php
e) Linux basics:www.distro.ibiblio.org/damnsmall/current/dsl-4.4.10-embedded.zip
f) Linux basics: https://nptel.ac.in/courses/117106113
g) Linux basics : https://onlinecourses.swayam2.ac.in/aic20_sp24/preview
h) https://www.guru99.com/introduction-linux.html

15. PO-COMPETENCY-CO MAPPING

Semester 3	Linux with Operating System Concepts (Course Code : 4331602)						
	POs						
Competency & Course Outcome	PO1 Basic & Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Develop-ment of Solutions	PO4 Engineering Tools, Experimen-tation &Testing	PO5 Engineering Practices for Society, Sustainability & Environment	PO6 Project Management	PO7 Lifelong Learning
Competency	**Perform Linux shell scripts for resource management in Operating System.**						
Course Outcomes CO a) Differentiate various operating systems & explain Linux Operating System.	2			1			1
CO b) Illustrate various aspects of process scheduling and deadlock management.	2	2	2	1		1	1
CO c) Understand various file management and file allocation techniques.	2	1	2	2		1	1

CO d) Justify the need of security and protection mechanism in Operating System.	2	2	2	1	2	1	2
CO e) Perform various Linux command and develop shell scripts.	2	2	2	3	1	1	2

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

SR. No.	Name and Designation	Institute	Email
1	Dr. Gaurang V. Lakhani H.O.D, Department of Information Technology. GES Class-I	Government Polytechnic, Himatnagar.	gvlakhani1@gmail.com
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