GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-III

Course Title: Basics of Operating System
(Course Code: 4330703)

Diploma programme in which this course is offered	Semester in which offered
Computer Engineering	Third

1. RATIONALE

As a core subject of Computer Engineering, this course enables to understand importance of Operating System, its functionalities to manage resources of Computer and Peripherals, program development and its execution. Every student of computer science must therefore understand basic structure of an operating system. After learning this subject student will be able to discriminate between various types of operating systems, its processor, processes, and memory and file management. The subject also emphasizes on Linux utilities and scripting.

2. COMPETENCY

The course content should be taught and implemented with the aim to develop various types of related skills leading to the achievement of the following competency

- **Manage operations of Operating Systems.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

The practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

a) Differentiate operating systems based on their features.
b) Apply scheduling algorithms to calculate turnaround time and average waiting time.
c) Interpret various memory management techniques.
d) Apply File management techniques.
e) Execute basic Linux commands and Shell scripts.

4. TEACHING AND EXAMINATION SCHEME

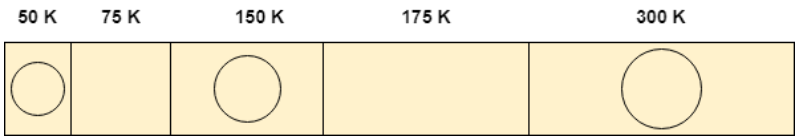
Teaching Scheme (In Hours)			Total Credits (CI+T/2+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
CI	T	P	C	CA	ESE	CA	ESE	
3	0	2	4	30	70	25	25	150

Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 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: CI-ClassRoom Instructions; 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) that are the sub-components of the COs. *Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO. These PrOs need to be attained at least at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'*.

<table>
<tr><th>Sr.No</th><th>Practical Outcomes (PrOs)</th><th>Unit No.</th><th>Approx. Hrs. Req</th></tr>
<tr><td>1</td><td>Compare windows and Linux OS. (latest version)</td><td>I</td><td>02</td></tr>
<tr><td>2</td><td>Solve below given example with SJF, FCFS and Round robin algorithm. Draw Gantt chart.
<table>
<tr><th>Process</th><th>Arrival Time</th><th>Execution Time</th><th>Service Time</th></tr>
<tr><td>P0</td><td>0</td><td>5</td><td>0</td></tr>
<tr><td>P1</td><td>1</td><td>3</td><td>5</td></tr>
<tr><td>P2</td><td>2</td><td>8</td><td>8</td></tr>
<tr><td>P3</td><td>3</td><td>6</td><td>16</td></tr>
</table></td><td>II</td><td>02</td></tr>
<tr><td>3</td><td>Process requests are given as:
25 K , 50 K , 100 K , 75 K
 

Solve above example using following algorithms:
1. First fit
2. Best fit
3. Worst fit</td><td>III</td><td>02</td></tr>
<tr><td>4</td><td>Page replacement algorithms
a. First in First out (FIFO) - Consider page reference string 1, 3, 0, 3, 5, 6, 3 with 3 page frames. Find the number of page faults.
b. Least Recently Used – Consider the page reference string 7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 2 with 4 page frames. Find number of page faults.</td><td>III</td><td>04</td></tr>
<tr><td>5</td><td>Disk Scheduling Algorithms</td><td>IV</td><td>04</td></tr>
</table>

	1. Scan: Suppose the requests to be addressed are-82,170,43,140,24,16,190. And the Read/Write arm is at 50, and it is also given that the disk arm should move **"towards the larger value".** 2. CScan: Suppose the requests to be addressed are-82,170,43,140,24,16,190. And the Read/Write arm is at 50, and it is also given that the disk arm should move **"towards the larger value".**		
6	Test and run basic unix commands.	V	02
7	Test and run Advanced unix commands.	V	02
8	Test commands related with File editing with Vi, Vim, gedit, gcc.	V	02
9	Create a shell script to read from command line and print "Hello".	V	02
10	Create a Shell script to read and display content of a file. And append content of one file to another	V	02
11	Create a Shell script to accept a string in lower case letters from a user, & convert to upper case letters.	V	02
12	Create a Shell script to add two numbers.	V	02
	Total		28

Note

i. *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.*

ii. *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..*

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Correctness of solution/answer	30
2	Interpret and Solve various algorithms	30
3	Debugging ability	20
4	Program execution/answer to sample questions	20
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS AND SOFTWARE REQUIRED

These major equipment/instruments and Software required to develop PrOs are given below with broad specifications to facilitate procurement of them by the administrators/management of the institutes. This will ensure conduction of practical in all institutions across the state in proper way so that the desired skills are developed in students.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Computer with latest configuration with windows or UNIX OS	All
2	Linux based Operating system	All

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 fulfil the development of this competency.

a) Work as a leader/a team member.
b) Follow ethical practices.

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 formulated as given below and only higher level UOs of *Revised Bloom's taxonomy* are mentioned for development of the COs and competency in the students by the teachers. (Higher level UOs automatically includes lower level UOs in them). If required, more such higher level UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit –1: Introduction of Operating System	1a. Explain needs of Operating system 1b. Classify types of Operating System 1c. Describe OS services – User point of view and System point of view.	1.1 Fundamental Goals of Operating system 1.2 Overview of Operating Systems i. Multi programming ii. Time Sharing iii. Real Time iv. Multithreading v. Distributed 1.3 Operating System services 1.4 Case Study ii. Linux iii. Latest Windows Operating System 1.5 Generations of Operating System
Unit– 2: Process Management	2a. Define process model 2b. Describe process Life Cycle	**Concepts of Process** 2.1 Overview of the Process & threads 2.2 Process Life Cycle/ Process States 2.3 Process Control Block

	2c. Compare different process scheduling algorithm. 2d. Compare different schedulers 2e. Describe Critical Section & mutual exclusion 2f. Identify conditions for Deadlock 2g. Solve Deadlock conditions using Resource allocation graph	**Process Scheduling** 2.4 Scheduling Criteria 2.5 Scheduling Algorithms i. First Come First Serve ii. Shortest Job First iii. Round Robin 2.6 Overview of Schedulers 2.7 Scheduling Queues 2.8 Context Switch **Process Synchronization** 2.9 Critical Section 2.10 Mutual Exclusion **Deadlock** 2.11 Conditions for Deadlock 2.12 Resource allocation graph
Unit– 3: Memory Management	3a. Describe memory management 3b. Differentiate Contiguous and Non- contiguous memory allocation 3c. Differentiate primary and secondary memory 3d. Apply different page replacement algorithms for memory allocation	**Memory Management** 3.1 Logical and physical address map 3.2 Swapping **Memory Allocation** 3.3 Contiguous memory allocation i. Fixed and variable partition ii. Internal and External Fragmentation and compaction iii. Memory relocation and protection mechanism iv. Allocation techniques – First Fit, Best Fit and Worst Fit 3. 4 Non Contiguous Memory allocation i. Overview of Paging ii. Address translation using basic method of paging iii. Overview of Segmentation iv. Page replacement algorithm – FIFO, LRU
Unit–4: File Management System	4a. Apply file management concepts in Operating System 4b. Explain Directory structure of Operating System 4c. Describe physical disk structure. 4d. Discuss Allocation methods of directory system.	**Files System** 4.1 Files Attributes 4.2 File Operations 4.3 File Types **Directory System** 4.4 Directory Structures 4.5 Protection 4.6 Allocation Methods – Contiguous, Linked **Secondary Storage Structure** 4.7 Disk Structure

	4e. Compare different disk scheduling algorithms.	4.8 Disk Scheduling Algorithm – SCAN, CSCAN
Unit–5: Linux Basics	5a. Test and Execute basic Linux commands 5b. Test and Execute shell commands in different shell scripts 5c. Develop shell scripts in 'Unix/ Linux'	5.1 Linux Introduction 5.2 Basic architecture of Unix/ Linux 5.3 Introduction to shell and commands 5.4 Commands: pwd, cd, mkdir, rmdir, ls, cat, cp, rm, mv, wc, split, cmp, comm, diff, head, tail, grep, sort 5.5 Editing files with "vi", "vim", "gedit", "gcc" **Linux Basic shell scripts** 5.6 Read using command line argument 5.7 the logical operators 5.8 Evaluate expression using test and [..] 5.9 Branching : if, case 5.10 Basic of Looping : while, for

***Note**: The UOs need to be formulated at the 'Application Level' and above of Revised Bloom's Taxonomy' to accelerate the attainment of the COs and the competency.*

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction of Operating System	06	04	06	00	10
II	Process Management	12	06	10	04	20
III	Memory Management	10	06	06	04	16
IV	File Management System	06	04	06	00	10
V	Linux Basics	08	02	04	08	14
Total		**42**	**22**	**32**	**16**	**70**

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

***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions 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 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 conduct following activities in group and prepare small reports (of 1 to 5 pages for each activity). For micro project report should be as per suggested format, for other activities students and teachers together can decide the format of the report. Students should also collect/record physical evidences such as photographs/videos of the activities for their (student's) portfolio which will be useful for their placement interviews:

a) Undertake micro-projects in teams.

b) Prepare charts to explain use/process of the identified topic.

c) *https://boonsuen.com/process-scheduling-solver*, this website gives output for various process scheduling algorithms, students are expected to solve examples and crosscheck with output.

d) An hour of problem solving for various process and disk scheduling algorithms may be organized and students are encouraged to participate

e) Students are encouraged to register themselves in various MOOCs such as: Swayam, edx, Coursera, Udemy etc to further enhance their learning.

f) List different versions of Linux and windows operating system

g) Encourage students to form a coding club at institute level and can help the slow learners

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES

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) Guide student(s) in undertaking micro-projects.

c) Managing Learning Environment

d) Diagnosing Essential Missed Learning concepts that will help for students.

e) Guide Students to do Personalized learning so that students can understand the course material at his or her pace.

f) Encourage students to do Group learning by sharing so that teaching can easily be enhanced.

g) ***'CI" in section No. 4***means different types of teaching methods that are to be employed by teachers to develop the outcomes.

h) 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***, but to be assessed using different assessment methods.

i) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.

j) Guide students on how to address issues on environment and sustainability using the knowledge of this course

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 are 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 total work load on each student due to the micro-project should be about ***16 (sixteen) student engagement hours*** (i.e., about one hour per week) during the course. The students ought to submit micro-project by the end of the semester (so that they develop the industry-oriented COs).

A suggestive list of micro-projects is given here. This should relate highly with competency of the course and the COs. Similar micro-projects could be added by the concerned course teacher:

a) A Comparative Analysis of Operating System: case study of Windows Operating and Mac OS. Comparing factors like booting process, user interface, handling system resources, device management, file management, security.

b) A Comparative Analysis of Operating System: case study of Windows Operating and Linux based OS. Comparing factors like booting process, user interface, handling system resources, device management, file management, security.

c) Comparing features of Windows 7, Windows 8 and Windows 10.Also show newly added functionality in each version.

d) Case study on different Disk scheduling algorithms. Describe working of each algorithm.

e) Case study on different Process scheduling algorithms. Describe working of each algorithm.

f) Case Study on different page replacement algorithms. Describe working of each algorithm.

g) Case study on fragmentation in operating system.

h) Case Study in shell script on how to ask for user input until valid input is given. Also illustrates how to check if no characters were input, check if input exceeds 30 characters in length, check if input lacks both first and last name, exit if too many wrong answers.

i) Animate the Disk scheduling algorithms.

j) Animate the Process scheduling algorithms.

k) Animate the Page replactement algorithms.

l) Case study any one scheduling algorithms in the cloud.

m) Case study on any one cloud operating system.

n) Case study on any one real time operating system.

o) Case study on any one mobile operating system.

p) Case study on any one server operating system.

q) Case study on any one distributed operating system.

r) Case study on any one network operating system.

s) Case study on any one time sharing or multitasking operating system.

t) Case study on any one batch processing system.

u) Case study on shell commands in detail.

v) Case study on advanced shell command.

w) Case study on any operating system used in smart gadgets.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Operating System Concepts, 9th Edition	Abraham Silberschatz, Peter B Galvin, Gerg Gagne	WILEY, 2016, ISBN - 978-8126554270
2	Unix Concepts And Application, 4th Ed	Sumitabha Das	MGH, ISBN – 0-07-063546-3
3	Modern Operating System 3rd Ed	Andrew Tanenbaum, Herbert Bos	2015,Pearson, ISBN – 9780133591620
4	Operating System, 2nd Ed	Milan Milenkovic	2014, MGH, ISBN-13: 978-0-07-463272-7
5	Linux –Application and Administration	Ashok Kumar Harnal	2009,TMH, ISBN-13: 978-0070680104

14. SUGGESTED LEARNING WEBSITES

a) https://boonsuen.com/process-scheduling-solver
b) http://cpuburst.com/ganttcharts.html
c) https://codepen.io/faso/pen/zqWGQW
d) https://www.tutorialspoint.com
e) www.w3schools com
f) https://nptel.ac.in/courses/106106144
g) https://nptel.ac.in/courses/106105214
h) https://nptel.ac.in/courses/106102132

15. PO-COMPETENCY-CO MAPPING

Semester II	Basics of Operating System (Course Code:)									
	POs and PSOs									
Competency & Course Outcomes	**PO 1 Basic & Discipline specific knowledge**	**PO 2 Problem Analysis**	**PO 3 Design/ development of solutions**	**PO 4 Engineering Tools, Experimentation &Testing**	**PO 5 Engineering practices for society, sustainability & environment**	**PO 6 Project Management**	**PO 7 Life-long learning**	**PSO 1**	**PSO 2**	**PSO 3** (If needed)
Competency **Develop shell scripts in 'Unix/ Linux' using Operating System Concepts.**										
Course Outcomes CO a) Differentiate Operating Systems based on features	2	-	-	-	-	-	1			
CO b) Interpret various aspects of Process management	2	2	2	-	-	-	1			
CO c) Interpret various memory management techniques	2	2	2	-	-	-	1			
CO d) Interpret various File management techniques.	2	2	2	-	-	-	1			
CO e) Execute basic Linux commands and Shell scripts.	3	2	2	3	-	-	-			

Legend: '**3**' for high, '**2**' for medium, **'1'** for low or **'-'** for the relevant correlation of each competency, CO, with PO/ PSO

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
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