	Programme : Diploma in Computer Engineering		
Course Code:CO23109		**Course Title : Operating System**	
	Compulsory / Optional: Compulsory		

Teaching Scheme and Credits						**Examination Scheme**							
CL	**TL**	**LL**	**SLH**	**NLH**	**Credits**	**FA-TH**		**SA-TH** (2Hrs.30 Min)	**FA-PR**	**SA**		**SLA**	**Total**
						T1	**T2**			**PR**	**OR**		
3	**--**	**2**	**1**	**6**	**3**	**20**	**20**	**60**	**25**	**25#**	**--**	**25**	**175**

Abbreviations: CL- ClassRoom Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, SLA- Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination, @$ Internal Online Examination

Note:

1. FA-TH represents Total of two class tests of 20 marks each conducted during the term.
2. FA-PR represents Tutorial Term work of 25 Marks
3. SLA represents self learning Assessment of 25 Marks
4. SA-TH represents the end term examination of 60 Marks

I. Rationale

An Operating system is the basic system software that makes a computers system operational. It acts an interface between the user and the computer system. It is the essential software that manages computer hardware and software resources and provides common services for computer programs. Operating system is a core technology subject, it familiarizes the students with the concepts, structure and functions of Operating System.This course is aimed to teach and practice the concept of Operating System design.

II. Course Outcomes: Students will be able to achieve & demonstrate the following COs on completion of course based learning.

CO1	Demonstrate basic knowledge about operating system
CO2	Identify various OS components, services & structure
CO3	Describe the concept of Process and Threads
CO4	Apply various CPU Scheduling Algorithm.
CO5	Estimate efficiency of various memory management techniques
CO6	Illustrate File allocation and access methods

III. Course Content Details:

Unit No.	Theory Learning Outcomes (TLO's)aligned toCO's.	Topics / Sub-topics
1	TLO 1.1 Explain the functioning of Operating System. TLO 1.2- Explain characteristics of the given type of operating system. TLO 1.3 Identify type of OS suitable for given type of application.	**Operating System Overview** 1.1 Introduction To Operating System : Concept, Components Of Computer System 1.2 Role Of The Operating System 1.3 Different Types Of Operating Systems- Batch Operating System, Multiprogramming System, Multitasking Operating System, Time Shared System, Multiprocessor Systems, Cluster Systems, Distributed Systems, Real Time Systems, Open Source Operating System, Mobile Operating System 1.4 Command line based OS – DOS ,UNIX GUI based OS -WINDOWS,LINUX **Course Outcome: CO1 Teaching Hours : 05 Marks: 05**
2	TLO 2.1 Start, stop, and restart the given Different Services of Operatlng System. TLO 2.2 Explain use of the given Components of OS. TLO 2.3 Explain use of the given operating system tool.	**Operating System Components & Structure** 2.1 Operating System Components: Process Management, Main Memory Management, Secondary Storage Management, I/O System Management, File Management. 2.2 Operating-System Services 2.3 Operating System Structure: Simple Structure, Layered, Monolithic, Microkernel 2.4 System Calls - Concept, Types & Uses of System Call: Process Control, File Management, Device Management, Information Maintenance, Communication. **Course Outcome: CO2 Teaching Hours : 06 Marks: 07**
3	TLO3.1 Explain functions carried out in the given process state. TLO 3.2 Describe the fuliction of the given component of process stack 1n PCB. TLO 3.3 Explain characteristics of the given multithreading model. TLO 3.4 Descrlbe method of executing the given process command with example.	**Process Management** 3.1 Process-Concept, Process States, Process Control Block 3.2 Process Scheduling- Scheduling Queues, Schedulers, Context Switch. 3.3 Inter-Process Communication- Introduction, Shared Memory System & Message Passing System 3.4Threads – Benefits, Users And Kernel Threads 3.5Multithreading Models – Many To One, One To One, Many To Many **Course Outcome: CO3 Teaching Hours : 06 Marks: 08**

4	TLO4.1 Justify the need and objective of given job scheduling criteria with relevant example. TLO 4.2 Explain with example the procedure of allocating CPU to the given process using the specified OS. TLO 4.3 Calculate turnaround time and average waiting time of the glven scheduling algorithm. TLO 4.4 Explain functioning of the given necessary condition leading to deadlock.	**CPU Scheduling & Deadlock** 4.1 Scheduling Objectives, Concept, CPU And I/O Burst Cycles, Pre-Emptive & Non- Pre-Emptive Scheduling, Scheduling Criteria. 4.2 Types Of Scheduling algorithms –First Come First Served (FCFS), Shortest Job First (SJF),Shortest Remaining Time (SRTN), Round Robin (RR), Priority Scheduling, Multilevel Queue Scheduling 4.3 Deadlock: System Model, Necessary Conditions Leading To Deadlocks,Deadlock Handling,Deadlock Prevention 4.4 Deadlock Avoidance: Safe State, Resource allocation Graph Bankers algorithm ,Data Structure Of Banker's algorithm, Safety algorithm, Resource-Request Algorithm, Illustrative Examples **Course Outcome: CO4 Teaching Hours : 12 Marks: 18**
5	TLO 5.1 Describe the working of specified memory management function. TLO 5.2 Explain characteristic of the given memory management techniques. TLO 5.3Write algorithm fo1' the given page replacement technique. TLO5.4 Calculate Page fault for the given p a g e reference string	**Memory Management** 5.1. Background – Basic Memory Hardware, Address Binding, Logical& Physical Address Space, 5.2. Swapping 5.3. Contiguous Memory Allocation, Fragmentation. 5.4. Paging, Page Table, Page Fault, Segmentation 5.5. Virtual Memory – Concept, Demand Paging. 5.6. Page Replacement Algorithms- First In First Out (FIFO), Least Recently Used (LRU), Optimal Page Replacement, Not Recently Used (NRU**).** **Course Outcome: CO5 Teaching Hours : 12 Marks: 18**
6	TLO 6.1 Explain structure of the given file system with example. TLO 6.2 Descrlbe mechanism of the given file access method. TLO 6.3 Explain procedure to create and access directories and asslgn the given files access permlsslons.	**File System** **6.**1 File – Concepts, Attributes, Operations, Types, File System Structure, 6.2 Access Methods – Sequential, Direct, Swapping 6.3 File Allocation Methods- Contiguous , Linked, Indexed 6.4 Directory Structure – Single Level, Two Level ,tree-structured directory **Course Outcome: CO6 Teaching Hours : 04 Marks: 04**

IV. Laboratory Learning Outcome and Aligned Practical / Tutorial Experiences.

Sr.No	Laboratory Learning Outcome	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
1	LLO1.1 Identify type of OS suitable for given type of application	Compare various operating systems according to different criteria **Operating systems to be considered** - MS-DOS, Windows selected versions, OS/2, Mac OS, Linux, Android, iOS etc. **Criteria**- Creator/ Produced by, Initial Public release, Target system type, File system supported, Kernel type, GUI default ,Update management, Native APIs, Non-native APIs supported through subsystems, etc.	2	CO1

<table>
<tr><td>2</td><td>LLO2.1 Install and Configure different Operating systems.</td><td>Install and configure Windows, Linux (or alike) operating system.</td><td>4</td><td>CO1</td></tr>
<tr><td>3</td><td>LLO3.1 Execute Linux basic commands</td><td>3.1 Execute general purpose commands date, time, cal, clear, banner, tty, script, man.
3.2 Work with multiple linux terminals and basic commands: who, who am I, login, passwd, su, pwd.
3.3 Execute text processing commands tr, wc, cut, paste, sort,cmp,diff.</td><td>2</td><td>CO2</td></tr>
<tr><td>4</td><td>LLO4.1 Execute File and direcotory commands in Linux.</td><td>Execute file and directory manipulation commands ls, rm, mv, cp, join, split, cat (file saving and redirection operator), head, tail, touch, diff, comm., pr, chmod, mkdir, rmdir, cd, pwd, dir, cmp. (Use wild card character).</td><td>4</td><td>CO2</td></tr>
<tr><td>5</td><td>LLO5.1 Execute process commands</td><td>Execute process commands- ps, wait, sleep, exit, kill.</td><td>2</td><td>CO3</td></tr>
<tr><td>6</td><td>LLO6.1 Implementation of IPC</td><td>Write a program to implement IPC through Shared Memory.</td><td>2</td><td>CO3</td></tr>
<tr><td>7</td><td>LLO7.1 Use Operating system services</td><td>6.1Use Operating system services(Editor, GUI, File handling.)
6.2Run commands to start, stop, and restart the specified service in Linux</td><td>2</td><td>CO2</td></tr>
<tr><td>8</td><td>LLO8.1Implement CPU Scheduling algorithms</td><td>Write a program to implement First Come First Serve,Shortest job first and Round Robin Scheduling Algorithm. Calculate average waiting time, average turnaround time and throughput.(Given the list of Processes, their CPU burst times)
<table><tr><th>Process</th><th>Burst Time</th></tr><tr><td>P1</td><td>6</td></tr><tr><td>P2</td><td>8</td></tr><tr><td>P3</td><td>7</td></tr><tr><td>P4</td><td>3</td></tr></table>(Course Teacher may give different Processes & Burst Times to students)</td><td>6</td><td>CO4</td></tr>
<tr><td>9</td><td>LLO9.1 Implement Page Replacement Algorithms</td><td>Write a program to implement First in first out (FIFO) Page replacement algorithm. Calculate number of page fault and page fault rate for following reference string sequence and 3 memory frames. (Course Teacher may give different reference Strings to students)
1,2,3,4,2,1,5,6,2,1,2,3,7,6,3,2,1,2,3,6</td><td>2</td><td>CO5</td></tr>
<tr><td>10</td><td>LLO10.1 Implement Page Replacement Algorithms</td><td>Write a program to implement First in first out (LIFO) Page replacement algorithm. Calculate number of page fault and page fault rate for following reference string sequence and 3 memory frames. (Course Teacher may give different reference Strings to students)
1,2,3,4,2,1,5,6,2,1,2,3,7,6,3,2,1,2,3,6</td><td>2</td><td>CO5</td></tr>
</table>

V. MicroProject :

1.Design a file Explorer having advanced features like file Compression,Encryption and permission.
2.Develop a Process Scheduling Simulator
3. Design a chat Application.
Any other microproject suggested by Subject Faculty.

VI. Assessment Methodologies/Tools

Formative assessment (Assessment for Learning)

- TH- Progressive /Periodic Test test each of 20 Marks
- TL - Continuous Assessment of Tutorials for 25 Marks
- SL - Continuous Assessment of Self Learning for 25 Marks

Summative Assessment (Assessment of Learning)

TH - Term End examination of 60 Marks

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CO1	3	1		-	1		1	1		-
CO2	3	1			1		1	1		
CO3	3	2	1	1	1	1	1	2	1	1
CO4	2	3	2	2	1	1	1	3	2	2
CO5	2	2	1	1	2	1	2	2	1	1
CO6	2	2	1	1	2	1	2	2	1	1
Legends: - High:03, Medium:02, Low:01, No Mapping: --										

VII. Suggested Learning Materials / Books

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Operating System Concepts	Abraham Silberschatz, Greg Gagne, Peter B. Galvin Wiley India Limited 10th Edition, April 2018	ISBN: 978-1-119-32091-3/ ISBN: 978-1-119-75313-1
2	Operating Systems: Internals and Design Principles	William Stallings Pearson Education, India,	ISBN-13: 9789332518803

		9th Edition, March 2018	
3	Modern Operating Systems	Andrew S. Tanenbaum, Herbert Bos, Prentice Hall of India 4th Edition, September 2014	ISBN:1292061421 (ISBN13: 9781292061429)
4	Operating system	Godbole Atchyut S. Tata McGraw-Hill Education, 3rd Edition, 2015	ISBN-13: 9780070702035

VIII. Learning Websites & Portals

https://www.javatpoint.com/os-tutorial
https://courses.cs.vt.edu/csonline/OS/Lessons/Processes/index.html
https://en.wikipedia.org/wiki/Operating_system
https://computer.howstuffworks.com/operating-system.htm

IX. Academic Consultation Committee/Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Ms. Bhakti R. Khajone	Senior Project Engineer	WIPRO Technology, Pune
2	Mrs. Poonam Vegurlekar	Lecturer in Computer Engg.	Thakur Polytechnic Mumbai
3	Mrs. N. H. Vachani	Lecturer in Computer Engineering	Government Polytechnic

Coordinator,
Curriculum Development,
Department of _____ Engineering

Head of Department
Department of _____ Engineering

I/C, Curriculum Development Cell

Principal