Course Information

Course Title: Operating Systems		**Code:** SET-224
Program: B.E(TECH)-Software	**Semester: 4th**	**Credit Hours:** 2+1 **Lecture:** 32 **Practical:** 14
Knowledge Area (as per HEC curriculum template)	CET Foundation - IV	

1. **Course description:**

   This course provides a comprehensive introduction **to** Operating Systems (OS**)**, their functions, and their role in managing hardware and software resources. It covers **e**ssential concepts such **as** process management, memory management, file systems, CPU scheduling, and inter-process communication**.** Students will gain hands-on experience in Linux-based environments**,** learning about system calls, process synchronization, shell scripting, scheduling algorithms, and memory management techniques**.** The course also explores deadlocks, virtualization, and security mechanisms in modern operating systems.

2. **Course Objectives:**

   By the end of the course, students will:
   - Understand the functions of operating system and describe internal structure and its components.
   - Analyze process management and scheduling algorithms. Evaluate synchronization technique and inter-process communication.
   - Discuss different memory management techniques. Explain file system architecture
   - Identify security challenges in operating systems.

3. **Course Learning Outcomes (CLOs):**

CLO No.	CLO Description	Domain and Taxonomy level	PLO mapped (i to xii)	Level of emphasis of the PLO (1=High; 2=Medium; 3=Low)
1.	Identify the role of an operating system and explain its evolution, key concepts and internal structure.	C2	i	1
2.	Apply various concepts and strategies involved in Process management, scheduling, and memory management and file system.	C3	ii	2
3.	Explain the security challenges associated with modern operating system and the future trends in distributed systems and network system architectures.	C2	vii	2
4.	Implement OS functions and services in an appropriate platform.	P3	iii	2
5.	Analyze OS installation and management issues using effective team collaborative task.	A3	ix	2

Note:

- ✓ *C → Cognitive, P → Psychomotor, A → Affective domains and 'n' is the taxonomy level.*
- ✓ *It is strongly suggested that one CLO should be mapped to one PLO and one domain only.*

Teaching Plan

4. Weekly Lecture Breakdown

Week #	Topic(s) to be covered	CLO #
1	Introduction, Goals of operating system	CLO # 01
2	Services provided by Operating system, Functions of Operating systems Evolution of OS, OS Structure	CLO # 01
3	Modes of operation (Kernel and user mode), System calls, types of system calls.	CLO # 01
4	Introduction to process management-Process control block, Process states-Process 2 state models, Process creation and termination and suspension	CLO # 02
5	Process 5 states model, Process control structures Process context switch, mode switch,	CLO # 02
6	Multithreading-Process and threads, Threads Types-User and kernel level threads. CPU scheduling, Goals of scheduling	CLO # 02
7	Scheduling algorithms: FCFS, SJF, SRTF, RR, Priority-based	CLO # 02
8	Inter-Process Communication: process cooperation and synchronization, race condition, critical section, mutual exclusion and implementation, semaphores, classical inter-process communication problems.	CLO # 02
Midterm Examination		
9	Deadlocks: System Model, deadlock characterization-necessary conditions, resource allocation graph (RAG)	CLO # 02
10	Methods for handling deadlock-deadlock avoidance, deadlock detection, deadlock prevention, recovery from deadlock.	CLO # 02
11	Memory management techniques-contiguous and non-contiguous, paging and segmentation, translation lookaside buffer (TLB) and overheads.	CLO # 02
12	Segmentation, translation lookaside buffer (TLB) and overheads.	CLO # 02
13	Virtual memory and demand paging, page faults, page replacement algorithms, thrashing and working set model	CLO # 02
14	File systems-introduction, disk space management and space allocation strategies, directory structures, disk caching,	CLO # 02
15	File Organization: Sequential, Index, Index Sequential Disk arm scheduling strategies: FCFS, SSTF, SCAN, CSACN, LOOK, CLOOK,	CLO # 02
16	Distributed system and network System architecture.	CLO # 03

Lab-work Plan

5. Experiment/Practical Breakdown

Experiment #	Experiment Title	CLO #
01	**Installation Of Linux OS** Installation of Linux OS and some basic Linux commands	**5**
02	**Files and directories** Managing Files & Directories in Linux	**5**
03	**Shell Scripting:** Programming using Shell Scripting.	4
04	**Conditional Statements:** Focusing on the usage of the test command and conditional statements.	4
05	**Iterative Statements:** Focusing on the usage of iteration statements and functions in shell programming	4
06	**Process Creation:** Understanding Process. Process creation in Linux. • Fork () method. Zombie and Orphan processes.	4
07	**Threads:** Understanding Threads Multithreaded programming using Python	4
08	**Scheduling Algorithms** Simulation of FCFS CPU scheduling algorithm. Simulation of SJF CPU scheduling algorithm.	4
09	**Scheduling Algorithms** Simulation of Round Robin CPU scheduling algorithm. Simulation of Priority CPU scheduling algorithm	4
10	**Semaphores** Implementation of Semaphore Mechanism. Solving producer-consumer (Classical Problem) problem in Python using semaphores	4
11	**Inter-process Communication using shared Memory:** Multiprocessing in Python. Implement Shared Memory using multiprocessing module in Python.	4
12	**Deadlock** Implementation of Deadlock Avoidance Mechanism (Banker's Algorithm)	4
13	**Page replacement algorithms** Simulation of FIFO, OPR, LRU, MRU page replacement algorithms	4
14	**Open Ended Lab Activity**	**5**

6. Syllabus and Books:

Introduction, services provided by OS, functions of OS, system calls. Process control block, process states, process context switch, threads: user-level and kernel level. Goals of scheduling, CPU scheduling algorithms: FCFS, SJF, SRTF, RR, Priority-based. Process cooperation and synchronization, race condition, critical section, mutual exclusion and Implementation, semaphores, classical inter-process communication problems. System Model, deadlock characterization-necessary conditions, resource allocation graph (RAG), methods for handling deadlock-deadlock avoidance, deadlock detection, deadlock prevention, recovery from deadlock.
Memory management techniques-contiguous and non-contiguous, paging and segmentation, translation lookaside buffer (TLB) and overheads. Virtual memory and demand paging, page faults, page replacement algorithms, thrashing and working set model.
File Management System Introduction, disk space management and space allocation strategies, directory structures, disk caching, disk arm scheduling strategies: FCFS, SSTF, SCAN, CSACN, LOOK, CLOOK .File Organization: Sequential, Index, Index Sequential

Text/Reference Books:

- Abraham Silberschatz, Greg Gagne, Peter B. Galvin, “Operating System Concepts”, Wiley, 10th edition, 2018, ISBN: 978-1-119-32091-3 or latest edition.
- William Stallings, “Operating Systems: Internals and Design Principles”, Pearson, 9th edition, 2018, ISBN-13: 9780134670959 or latest edition.

7. Percentage of theoretical background, problems analysis and solution design

Elements covered in the course	Percentage of full course coverage
Theoretical background	50%
Problem analysis	30%
Solution design	20%

8. Teaching and learning methods:

a. Lecture
b. Class discussion/ Videos
c. Presentation
d. Homework

9. Student assessment methods:

a. Quiz
b. Assignment
c. Exams (Theory)
d. Presentation
e. Project

10. Assessment schedule:

a. Quiz	throughout the semester	
b. Assignment	throughout the semester	
c. Exams		
d. Midterm exam	Week	9
e. Final theory exam	Week	18
f. Presentation	Week	17

11. Weighting of assessments:

Theory:

a.	Quizzes/Activities	10 Marks
b.	Assignments/Presentation	20 Marks
c.	Midterm examination	20 Marks
d.	Final term examination	50 Marks
	Total	100 Marks

Lab:

a.	Sessional	20 Marks
b.	Final Lab examination/ viva	30 Marks
	Total	50 Marks

12. Facilities required for teaching and learning

a. Computer Usage
b. Software
c. Online board + online ppt writing
d. YouTube

Course group leader name: **Engr Bushra Aziz**

S. No.	Course group member (if any)	Theory/Lab	Signature
1	**Engr Bushra Aziz**	Theory	
2	**Engr Bushra Aziz**	Lab	

Recommended by the Program coordinator	Verified by the department Chairperson
Endorsed by the Dean of the faculty	**Approved by the Provost**

Program Learning Outcomes (Bachelor of Engineering Technology Program):

(i) **Engineering Technology Knowledge (SA1)**: An ability to apply knowledge of mathematics, natural science, Engineering Technology fundamentals and Engineering Technology specialization to defined and applied Engineering Technology procedures, processes, systems or methodologies.

(ii) **Problem Analysis (SA2)**: An ability to Identify, formulate, research literature and analyze broadly defined Engineering Technology problems reaching substantiated conclusions using analytical tools appropriate to the discipline or area of specialization.

(iii) **Design/Development of Solutions (SA3)**: An ability to design solutions for broadly-defined Engineering Technology problems and contribute to the design of systems, components or processes to meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

(iv) **Investigation (SA4)**: An ability to conduct investigations of broadly-defined problems; locate, search and select relevant data from codes, data bases and literature, design and conduct experiments to provide valid conclusions.

(v) **Modern Tool Usage (SA5)**: An ability to Select and apply appropriate techniques, resources, and modern technology and IT tools, including prediction and modelling, to broadly-defined Engineering Technology problems, with an understanding of the limitations.

(vi) **The Engineering Technologist and Society (SA6)**: An ability to demonstrate understanding of the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to Engineering Technology practice and solutions to broadly defined Engineering Technology problems.

(vii) **Environment and Sustainability (SA7)**: An ability to understand and evaluate the sustainability and impact of Engineering Technology work in the solution of broadly defined Engineering Technology problems in societal and environmental contexts.

(viii) **Ethics (SA8)**: Understand and commit to professional ethics and responsibilities and norms of Engineering Technology practice

(ix) **Individual and Team Work (SA9)**: An ability to Function effectively as an individual, and as a member or leader in diverse teams.

(x) **Communication (SA10)**: An ability to communicate effectively on broadly defined Engineering Technology activities with the Engineering Technologist community and with society at large, by being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

(xi) **Project Management (SA11)**: An ability to demonstrate knowledge and understanding of Engineering Technology management principles and apply these to one’s own work, as a member or leader in a team and to manage projects in multidisciplinary environments.

(xii) **Lifelong Learning (SA12)**: An ability to recognize the need for, and have the ability to engage in independent and life-long learning in specialist Engineering Technologies.