Course Outline
CSE 321: Operating Systems
Semester: Fall 2025

Course Description:

This course provides a general understanding of the principles and concepts governing the functions of operating systems and acquaints students with the state-of-the-art approaches that make the design, implementation, and operation of complex operating systems possible. The core of the course contains concurrent programming (threads and synchronization), inter-process communication, process and thread management, storage and resource management and communication, and an analysis on security and protection.

Prerequisites: CSE221: Algorithms

Co-requisites: None

Course Outcomes:

CO 1	**Understand** the concepts of processes and their management, CPU scheduling techniques, and **Apply** system calls for solving problems on process management, and **Analyze** security, and protection of OS.
CO 2	**Understand** the behaviors of threads and their management, process, and thread synchronization mechanisms, deadlocks, virtual machines and containers and **Apply** thread libraries for solving problems on thread management and synchronization.
CO 3	**Understand** mechanisms of main memory, and virtual memory management, and file systems concepts, and implementations of OS, and **Apply** the concepts to design complex file systems.

Mapping of CO-PO-Taxonomy Domain & Level- Delivery-Assessment Tool:

Sl.	CO Description	PO	Bloom's taxonomy domain/level	Delivery methods and activities	Assessment tools
CO 1	**Understand** the concepts of processes and their management, CPU scheduling techniques, and **Apply** system calls for solving problems on process management, and **Analyze** security, and protection of OS.	**PO1**	Cognitive/ Apply, Analyze	Lectures, notes, simulation demo, lab class	Midterm Exam, Final Exam, Lab Work
CO 2	**Understand** the behaviors of threads and their management, process, and thread synchronization mechanisms, deadlocks, virtual machines and containers and **Apply** thread libraries for solving problems on thread management and synchronization.	**PO2**	Cognitive/ Apply, Analyze	Lectures, notes, simulation demo, lab class	Midterm Exam, Final Exam, Lab Work
CO 3	**Understand** mechanisms of main memory, and virtual memory management, and file systems concepts, and implementation of file system, and **Apply** the concepts to design complex file systems.	**PO5**	Cognitive/ Understand, Apply, Analyze	Lectures, notes, simulation demo, lab class	Final Exam, Lab Work

Lesson Plan:

Sr. No.	Topic details	Time allocation	Related CO
1	Process concepts, states, Inter Process Communication (IPC), operation on the process (creation and termination).	**Week 1,2**	**CO1**
2	Threads overview, Multicore Programming, Multithreading Models, Thread Libraries, Threading Issues, and operating systems examples.	**Week 3**	**CO2**
3	Basic concepts of CPU scheduling, scheduling criteria, scheduling algorithms and simulations (FCFS, SJF, Priority, Round Robin), and Multilevel queue and Multilevel feedback queue algorithms.	**Week 4**	**CO1**
4	Concepts of Process Synchronization, Race Condition, Critical Section Problem, Mechanisms of Process Synchronization: Test and Set, Compare and Swap, Mutex locks, Semaphores, and Classical synchronization problems.	**Week 5, 6**	**CO2**
5	Main Memory Management Background, Address spaces, paging, implementation of page table, shared paging, hierarchical page table. Introduction of virtual memory, demand paging, the performance of demand paging, page fault handling, page replacement algorithms (FIFO, LRU, Optimal).	**Week 7, 8**	**CO3**
6	Magnetic Disk Structure Overview, Magnetic Disk Architecture, File Concepts, File Attributes, File Operations, Indexed File Allocation Method, UNIX Inode, File System Implementation, Crash consistency and journaling.	**Week 9, 10**	**CO3**
7	Security Problem, security violation categories and methods, security measure levels, program threats, implementing security defenses, firewall, goals and principles of protection, domain of protection, domain structure, domain implementation in unix and android, access matrix, revocation of access rights, mandatory access control, capability-based systems, other protection improvement methods and language-based protection.	**Week 11**	**CO1**
8	Concepts of Virtual Machines and Containers and differences between them, Concepts of Hypervisors, Mobile OS concepts.	**Week 12**	**CO2**

Lab Plan:

Sr. No.	Topic details	Time allocation	Related CO
1	**Basic Shell Commands:** Getting started, Linux Basics and Installing Ubuntu. Familiarizing with the Linux kernel. Working with the Terminal Panel. Learning how one can access and operate on different directories and files through Terminal using Shell Commands.	**Week 1**	**CO1**
2	**C Programming (Part 1):** Variables, Data types, Input/Output, Arithmetic Operations, Arrays, Pointers, String, Struct.	**Week 2**	**CO1**
3	**C Programming (Part 2):** Flow Control (If-Else), Loop, Function.	**Week 3**	**CO1**
4	**System programming in C:** Using UNIX system calls to get and understand process-related all the functionalities. **Term Project 1:** Implementing Shell	**Week 4**	**CO1**
5	**Threads:** Concept of thread, pthread in UNIX. **Thread Synchronization:** Learning concepts and implementations of mutex and semaphore. Solving race condition problems by using mutex and semaphore.	**Week 5, 6**	**CO2**
6	**Inter-Process Communication:** Learning and implementing various techniques of Inter-Process Communications such as pipes, shared memory and message passing in order to establish communication among multiple processes. **Term Project 2:** Implement File System Checker for VSFS	**Week 7, 8**	**CO2**
7	**Access Control:** Implement and compare ACL and CBAC access control models and simulate how these models grant or deny permissions to users based on static access control data structures.	**Week 9, 10**	**CO1**
8	Review class and Lab final.	**Week 11,12**	**CO1, CO2, CO3**

Course Assessment Methods:

Homework

Homework/assignments shall be designed to ensure that the students have the required knowledge to analyze and design control systems. Specifically, they will support the student's progress in the project/Laboratory

Quizzes

Quizzes will be designed to test the student's understanding of the course and to assess various course outcomes

Examinations

The exam shall contain problems designed to test knowledge and comprehension, to analyze control systems, and/or apply the engineering problem-solving method.

Laboratory Work

The students will have hands-on experience in the design and analysis of shell scripts in Linux OS. They will learn how to implement different kinds of algorithms used in OS. The students will be assessed during each Lab session via Lab performance and Lab exams.

Assessment Methods vs. Course Outcomes:

Assessment Methods	CO 1	CO 2	CO 3
Midterm Exam	X	X	X
Final Exam	X	X	X
Laboratory Works	X	X	X

Textbook:

1 Operating System Concepts Essentials by Abraham Silberschatz, Peter B. Galvin and Greg Agne, Wiley; 10th Edition (July 5, 2008). ISBN: 978-1119320913

2 Modern Operating Systems by Tanenbaum A.S., Prentice Hall; 4th Edition (2015). ISBN-13: 978-0133591620

3 Operating Systems: Three Easy Pieces by Remzi H. Arpaci-Dusseau and Andrea C. Arpaci-Dusseau, Arpaci-Dusseau Books, October, 2023 (Version 1.10), http://www.ostep.org

Course Policies:

Class Policy

- Classroom and laboratory attendance are mandatory. You should come to the classroom before the instructor. Latecomers may/ may not be allowed to enter the classroom. Students, who are absent over 30% of the class time will not be allowed to enter the final examination.
- You should turn off your cellular phone before entering the classroom. You should not leave the classroom to make or take cellular phone calls.
- You should bring a notepad and/or a writing instrument to every class and take detailed notes.

- You should pay attention to the instructor and participate in class discussions.
- You should not do other work during class time.

Honor Code

Any form of cheating, plagiarism, and/or academic dishonesty will result in an "F" grade in the course.

Late Work and Examinations

Late assignments will not be accepted. Students who know that they are going to miss class should make arrangements in advance. Exams will be closed book. There will not be any make-up for quizzes and midterm exams except the cases of hospitalization or detention

Grading Policies:

Students' grades are assigned according to the grading scale of the Brac University Undergraduate Study and Examinations Regulations. In addition, the faculty are allowed to take into consideration the class average and standard deviation to reflect the actual class performance for student grade assignments. The grades at the university will be indicated in the following manner:

Marks	Grades
90-100	A (4.0)
85- <90	A- (3.7)
80- <85	B+ (3.3)
75- <80	B (3.0)
70- <75	B- (2.7)
65- <70	C+ (2.3)
60- <65	C (2.0)
57- <60	C- (1.7)
55- <57	D+ (1.3)
52- <55	D (1.0)
50- <52	D- (0.7)
<50	F (0.0)
P	Pass
I	Incomplete
W	Withdrawal
R	Retaken

Course Assessment Methods:
Guidelines for CSE course teaching in BRAC University. The following assessment methods are based on a Theory Course with Lab.

Section	**Marks (%)**
1. Assignments	5 %
2. Quizzes/Class Tests	10 %
3. Mid Term Examination	25 %
4. Lab & Projects	25 %
5. Final	35 %
Total	**100 %**

CO-wise tentative marks distribution:

CO	**Marks (%)**
CO1	30%
CO2	35%
CO3	35%
Total	**100 %**

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