Course Syllabus

Course Code	Course Title	ECTS Credits
COMP-354	Operating Systems	6
Prerequisites	**Department**	**Semester**
COMP-221, COMP-335	Computer Science	Spring
Type of Course	**Field**	**Language of Instruction**
Required	Computer Science	English
Level of Course	**Lecturer(s)**	**Year of Study**
1st Cycle	Prof. Harald Gjermundrød	3rd
Mode of Delivery	**Work Placement**	**Corequisites**
Face-to-face	N/A	None

Course Objectives:

The main objectives of the course are to:

- describe and discuss Operating System structuring methods like monolithic, layered, modular, micro-kernel models.
- provide deep knowledge of abstractions, processes, and resources.
- make aware the concept of protection through the transition between user and system(kernel) mode.
- thoroughly discuss OS structures like ready list, process control blocks, and so forth.
- provide deep knowledge of the concept of processes and threads.
- thoroughly discuss dispatching, context switching, preemptive, and non-preemptive scheduling.
- cover in detail the “mutual exclusion” problem and some solutions.
- provide advanced knowledge of deadlock including: causes, conditions, and prevention.
- provide advanced knowledge of synchronization models and mechanisms (semaphores, monitors, condition variables, rendezvous).
- describe and discuss physical memory, memory management hardware, paging, and virtual memory.

Learning Outcomes:

After completion of the course students are expected to be able to:

1. critically compare and evaluate how computing resources are used by application software and managed by system software
2. compare and contrast the various ways of structuring an operating system such as object-oriented, modular, micro-kernel, and layered
3. describe and discuss the difference between kernel and user mode in an operating system
4. critically evaluate the difference between processes and threads
5. compare, contrast, and analyze the common algorithms used for both preemptive and non-preemptive scheduling of tasks in operating systems, such as FCFS, priority, shortest job first, round robin, and multi-layer schemes
6. analyze reasons for using interrupts, dispatching, and context switching to support concurrency in an operating system.
7. evaluate the need for concurrency within the framework of an operating system
8. demonstrate the potential run-time problems arising from the concurrent operation of many separate tasks
9. apply various approaches for solving the problem of mutual exclusion in an operating system
10. analyze memory hierarchy and cost-performance trade-offs
11. compare, contrast, and analyze the concept of virtual memory and how it is realized in hardware and software.

Course Content:

1. Introduction. History of operating systems, computer-system organization and architecture, operating system structure and operation.

2. Operating system structures. Operating system services and interfaces, system programs, operating system design and implementation. Desktop OS vs Mobile OS.

3. Processes. Process concepts, process scheduling, operations on processes, and cooperating processes.

4. Threads. Motivation, user and kernel threads, multithreading models, thread scheduling.

5. Processor (CPU) scheduling. Preemptive vs. non-preemptive, FCFS, SJF, Priority, RR, and multilevel queue.

6. Process Synchronization. Producer-consumer problem, mutual exclusion, Peterson solution, lock-based solution, and semaphores.

7. Deadlocks. System model, prevention, avoidance, detection, and recovery.

8. Memory Management. Logical and physical address space, swapping, and memory allocation.

9. Virtual Memory. Paging, segmentation, page replacement strategies.
10. File System. Interface and Implementation.

Learning Activities and Teaching Methods:

Lectures, Practical Exercises, Project Work, and Assignments.

Assessment Methods:

Final Exam, Midterm Exam, Project, and Quizzes.

Required Textbooks / Readings:

Title	Author(s)	Publisher	Year	ISBN
Operating Systems Concepts, 10th Ed.	Silberschatz, Gavin, and Gagne	Wiley	2018	978-1118063330

Recommended Textbooks / Readings:

Title	Author(s)	Publisher	Year	ISBN
Operating Systems: Three Easy Pieces	Remzi H. Arpaci-Dusseau and Andrea C. Arpaci-Dusseau	Arpaci-Dusseau Books	2023	*Version 1.10 Online*
Operating Systems: Internals and Design Principles, 9th Ed.	W. Stallings	Prentice Hall	2017	978-0134670959
Modern Operating Systems, 4th Ed.	A. Tanenbaum, H. Bos	Prentice Hall	2014	978-0133591620