Course description:

This course provides an in-depth examination of the principles of distributed systems in general, and distributed operating systems in particular. Covered topics include communication, processes, naming, synchronization, consistency and replication, fault tolerance and security. Moreover, in-depth coverage of RPC, RMI and socket programming are provided. A brief overview of advanced topics such as cloud computing, green computing, and mobile computing will be provided, time permitting.Principles and paradigms of distributed systems.

Aims and Objectives:

1. Present the principles underlying the functioning of distributed systems;
2. Expose students to modern and classic technology used in distributed systems and their software;
3. Expose students to past and current research issues in the field of distributed systems;
4. Provide experience in the implementation of typical algorithms used in distributed systems.

Intended Learning Outcomes (ILOs): Upon successful completion of this course, students will:

A. Knowledge and Understanding	
A1	**Concepts and Theories:** 1. Have a broad understanding of the central problems in distributed systems. 2. Have an understanding of the goals and architectures of distributed systems 3. Have knowledge of important issues in distributed systems, including time, inter-process communication, state management, distributed computing paradigms, middleware and naming 4. Have gained an understanding of the middleware technologies that support distributed applications such as RPC, RMI and object-based middleware 5. Have a good understanding of algorithmic approaches to distributed systems solutions.
A2	**Contemporary Trends, Problems and Research:** Propose newdist models that can serve real life applications.
A3	**Professional Responsibility:** A bide by laws and regulations of software development

B. Subject-specific skills	
B1	**Problem solving skills:** 1. Know how to write basic programs that address certain challenging distributed systems problems. 2. Program using remote procedure calls and remote methods 3. Design client server systems that incorporate replication, synchronization, fault tolerance and security
B2	**Modeling and Design:** 1. Be able to apply their knowledge in analyzing and designing distributed systems. 2. Have a good understanding of the compromises -- the choices -- that must be made when designing a distributed solution to IT problems. 3. Create an awareness of the major technical challenges in distributed systems design and implementation;

B3	**Application of Methods and Tools**:Implement Distributed Systems using modern computer programming languages such as Python

C. Critical-Thinking Skills	
C1	**Analytic skills:** Use analytic skills to analyze problems at hand and determine the appropriate solution
C2	**Strategic Thinking:** Use strategic thinking to propose efficient solutions for complex problems
C3	**Creative thinking and innovation**:Use creative thinking and innovation to mix different models and propose efficient solutions for complex problems

D. General and Transferable Skills (other skills relevant to employability and personal development)	
D1	**Communication:** Express and communicate ideas in written and oral forms.
D2	**Teamwork and Leadership:**Be cooperative members of a team
D3	**Organizational and Developmental Skills:**Plan for automating of systems
D4	**Ethical and Social Responsibility:** Understand that they are accountable for their actions and there must be a balance between economic growth and the welfare of society and environment**.**

Course Outline and Time schedule

Week	Hours	ILO's	Topic	Teaching Procedure	Assessment methods
1	3		Course Description	Lecturing with active participation, Cooperative learning.	Homework, quizzes, reports
2	3	A1-3	Introduction : Distributed System Definition, Goals, System Types	=	=
3,4		A1-3	Architecture: Architectural styles, Middleware Organization, System Architecture, Examples		
5	6	A1-3 B1-3	Process: threads, Virtualization, clients, Servers, Code migration	=	=
6,7	3	A1-3 B1-3	Communication: RPC, Message oriented, multicast communication	=	=
6			**Mid**		
7,8	6	A1-3	Naming: Structured naming, attribute-based naming	=	=
9,10	6	A1-3	Coordination: Clock Syn, Logical Clock, Mutual exclusion, election Algorithm, Location Systems	=	=
10, 11	6	A1-3	Consistency and Replication:Data-centric and client-centric consistency model,	=	=

			Replica managements, consistency protocol		
12	3	A1-3	Fault Tolerance: Failure model, process resilience, reliable communication	=	=
13	3	A1-3	Security: Threats , mechanisms channel, access control, management	=	=
14,15	6	C1-3 D1-4	Case Studies	=	=
			Final Examination		

References:

A. **Main Textbook:**
Distributed Systems 3rd edition Andrew Tannenbaum and Maarten van Steen, Prentice Hall, 2017

B. **Supplementary textbook(s), websites**
George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems: Concepts and Design", 3rd Edition, Addison-Wesley, 2001

Assessment Methods:

Methods	Grade	Date
Mid Exam	30%	
Assignments (Reports \Quizzes\ Seminar \ Tutorials ….)	30%	
Final Examination	40%	