University of Nicosia, Cyprus

Course Code	**Course Title**	**ECTS Credits**
COMP-415	Distributed systems	6
Department	**Semester**	**Prerequisites**
Computer Science	Fall, Spring	COMP-358, COMP-354, COMP-212
Type of Course	**Field**	**Language of Instruction**
Elective	Computer Science	English
Level of Course	**Year of Study**	**Lecturer(s)**
1st Cycle	4th	Dr Constandinos Mavromoustakis
Mode of Delivery	**Work Placement**	**Co-requisites**
Face-to-face	N/A	None

Objectives of the Course:

The main objectives of the course are to:

- explore the basic concepts of distributed systems along with the distributed algorithm designs and implementations
- provide students with deep knowledge and penetrate into theory of decentralized modeling and study up-to-date concepts, algorithms and internetworking issues for building modern distributed systems
- demonstrate and analyze the basic conceptual model and the parts of a distributed system, and design, develop and implement a distributed infrastructure-based system
- critically assess and acquire a deep knowledge on processes, threads, virtualization, code migration, consistency and replication issues in DS
- develop and illustrate different aspects of the DS enterprise as follows:
    - (i) The viewpoint of applications, i.e., what kinds of concepts and programming skills are fitted for the design of distributed systems and applications.
    - (ii) The viewpoint of the system designers and of the implementers, i.e., the system layers and their mapping to the design of distributed algorithms along with their implementations.

Learning Outcomes:

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

1. recognize communication protocols used in distributed systems
2. distinguish the concepts underlying the development of distributed application systems
3. identify the issues and problems, together with the potential solutions in implementing distributed systems
4. implement distributed software systems

5. explain various distributed computing paradigms and issues
6. have a clear and defined realization of the basic concepts of the major DS platforms
7. determine and demonstrate the various design issues in a distributed computing system
8. demonstrate and analyze the communications among processes at different hosts to facilitate distributed computing
9. quote and acquire the essential knowledge on threads as well as identify their interoperational characteristics, virtualization, code migration, consistency and replication issues in a DS
10. analyze as well as critically compare and distinguish synchronization and concurrency control for a distributed computing system
11. critically compare and evaluate how multi-process/multi-threaded approaches can enhance system performance and reliability
12. design and implement a modern distributed file system
13. demonstrate and sketch the advantage of cluster computing through experiments
14. research in state-of-the art areas of DS including hands-on experience in distributed programming using RPC or Java RMI

Course Contents:

1. Distributed Systems/Overview of Distributed Systems. Basic concepts of distributed systems and computer networks and their purposes, characteristics, advantages, and limitations, as well as their basic architectures, networking and applications
2. Foundations: System models & Interprocess communication Client-server model and its role in the development of distributed network systems. Cooperation between clients and servers/group servers in distributed network systems, and addresses extensions to the client-server model. Service discovery, transparency in distributed network systems is also a part of this section
3. Low level network programming using socket Communication and Internetworking in distributed computing systems. Network software in a hierarchy of layers, cross layer architectures, interfaces to the layers and to the cross layers, properties of the underlying communication system, network functions using the TCP/IP protocols, Internet protocol–IPv6 is also addressed
4. Distributed algorithms: Time synchronization & Distributed Mutual Exclusion
5. Interprocess Communication using Message-Passing Applications. Processes in a distributed network system for effective communication and the associated mechanisms between these processes. Also the message-passing based interprocess communication mechanism, i.e., the socket API is also addressed. Interprocess Communication using RPC, RPC tools, the DCE/RPC and the SUN/RPC, object-oriented paradigm and approach (the Remote Method Invocation (RMI) in Java)
6. Reliability and Replication Techniques. Fault tolerant mechanisms, design, recognize and identify of the major fault-tolerant concepts in a distributed environment, Reactive System Architecture, Proactive System Architecture and the efficient design in implementing these techniques for offering reliability
7. Systems middleware: Names services & Security /including Privacy, integrity and availability of resources in distributed network systems. Basic concepts for DS

Security, IP security, integrity mechanisms and encryption techniques, and in particular, the techniques for defense against Distributed Denial-of-Service attacks
8. System infrastructure: Distributed file systems
9. Distributed Network Systems (Case Studies). Case Studies will cover extensively the Process Management, Process Address Spaces in Unix, CORBA Architecture, Interface Definition Language (IDL), Examples of a DS in Java

Learning Activities and Teaching Methods:

Lectures, Lab Presentations, Lab Tutorials, Theoretical Exercises and Assignments.

Assessment Methods:

Tests/Quizes, Design project, Homework, Project, Mid-Term, Final Exam.

Required Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
George Coulouris, Jean Dollimore and Tim Kindberg	Distributed Systems, Concepts and Design	Fourth Edition, Addison Wesley	2005	0-321-26354-5

Recommended Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
Andrew S. Tanenbaum, Maarten Van Steen	Distributed Systems: Principles and Paradigms	Prentice Hall, 2nd edition	2006	978-013239227