Course Title: Distributed Systems (3 Cr.)
Course Code: CACS352
Year/Semester: III/VI
Class Load: 4 Hrs. / Week (Theory: 3Hrs. Tutorial: 1 Hr.)

Course Description

The course introduces basic knowledge to give an understanding how modern distributed systems operate. The focus of the course is on distributed algorithms and on practical aspects that should be considered when designing and implementing real systems. Some topics covered during the course are causality and logical clocks, synchronization and coordination algorithms, transactions and replication, and end-to-end system design. In addition, the course explores recent trends exemplified by current highly available and reliable distributed systems.

Course objectives

The objective of the course is to make familiar with different aspect of the distributed system, middleware, system level support and different issues in designing distributed algorithms and finally systems.

Course Contents

Unit 1. Introduction **4 Hrs.**
- 1.1 Characteristics
- 1.2 Design Goals
- 1.3 Types of Distributed Systems
- 1.4 Case Study: The World Wide Web

Unit 2. Architecture **4 Hrs.**
- 2.1 Architectural Styles
- 2.2 Middleware organization
- 2.3 System Architecture
- 2.4 Example Architectures

Unit 3. Processes **6 Hrs.**
- 3.1 Threads
- 3.2 Virtualization
- 3.3 Clients
- 3.4 Servers
- 3.5 Code Migration

Unit 4. Communication **5 Hrs.**
- 4.1 Foundations
- 4.2 Remote Procedure Call
- 4.3 Message-Oriented Communication
- 4.4 Multicast Communication
- 4.5 Case Study: Java RMI and Message Passing Interface (MPI)

Unit 5. Naming **5 Hrs.**
- 5.1 Name Identifiers, and Addresses
- 5.2 Structured Naming

5.3 Attribute-based naming
5.4 Case Study: The Global Name Service

Unit 5. Coordination **7 Hrs.**

6.1 Clock Synchronization
6.2 Logical Clocks
6.3 Mutual Exclusion
6.4 Election Algorithm
6.5 Location System
6.6 Distributed Event Matching
6.7 Gossip-based coordination

Unit 7. Consistency and Replication **5 Hrs.**

7.1 Introduction
7.2 Data-centric consistency models
7.3 Client-centric consistency models
7.4 Replica management
7.5 Consistency protocols
7.6 Caching and Replication in Web

Unit 8. Fault Tolerance **5 Hrs.**

8.1 Introduction to fault tolerance
8.2 Process resilience
8.3 Reliable client-server communication
8.4 Reliable group communication
8.5 Distributed commit
8.6 Recovery

Unit 9. Security **4 Hrs.**

9.1 Introduction to security
9.2 Secure channels
9.3 Access control
9.4 Secure naming
9.5 Security Management

Teaching Methods

The teaching faculties are expected to create environment where students can update and upgrade themselves with the current scenario of computing and information technology with the help of topics listed in the syllabus. The general teaching pedagogy that can be followed by teaching faculties for this course includes class lectures, laboratory activity, group discussions, case studies, guest lectures, research work, project work, assignments (Theoretical and Practical), and written and verbal examinations.

Evaluation System

Examination Scheme		
Internal Assessment	**External Assessment**	**Total**
40%	60% (3 Hrs.)	100%

References:

1. A.S. Tanenbaum, M. VanSteen, "Distributed Systems", Pearson Education.
2. George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems Concepts and Design", Third Edition, Pearson Education.
3. Mukesh Singhal, "Advanced Concepts in Operating Systems", McGraw-Hill Series in Computer Science.
4. Ajay D. Kshemkalyani, Mukesh Singhal, "Distributed Computing: Principles, Algorithms, and Systems", Cambridge University Press
5. Christian Cachin, Rachid Guerraoui, Luís, "Introduction to Reliable and Secure Distributed Programming", Springer