

CSPE3004 DISTRIBUTED SYSTEMS (3-0-0)

Course Objectives:

- To provide basic foundation with fundamental concepts and mechanisms of distributed computing systems.
- To have a broad and up-to-date coverage of the principles and practice in the area of Distributed Systems.
- To design distributed systems and algorithms that support distributed computing.
- To gain an understanding of the principles and techniques behind the design of distributed systems, such as locking, concurrency, scheduling, and communication across networks.
- To gain practical experience in designing, implementing, and debugging real distributed systems.

Module-I (08 Hrs)

Introduction to Distributed Systems: Definition, types and examples of Distributed Systems, Characteristics & Properties of Distributed Systems, Architecture of distributed system, Resource Sharing, Concurrent Programming, Transparency Issues

Distributed Computing Paradigms: Basic Message Passing Model – The Client Server, Message Passing, RPC basics, RPC implementation, RPC communication and issues, Remote Procedure Call Model

Module-II (08 Hrs)

Time and Global States: Introduction, Clocks Events and Process States, Synchronizing Physical Clocks, Logical Time and Logical Clocks, Global States, Distributed Debugging.

Coordination and Agreement: Introduction, Distributed Mutual Exclusion, Elections, Multicast Communication, Consensus and Related Problems, Interactive consistency Problem, Solution to Byzantine Agreement problem, Application of Agreement problem

Module-III (08 Hrs)

Inter Process Communication: Introduction, The API for the Internet Protocols, External Data Representation and Marshalling, Client-Server Communication, Group Communication, Case Study: IPC in UNIX.

Distributed Objects and Remote Invocation: Introduction, Communication between Distributed Objects, Remote Procedure Call, Events and Notifications, Case Study: JAVA RMI.

Module-IV (08 Hrs)

Consistency and Replication: Motivation, Object Replication, Consistency Models, Distribution Protocols, Consistency Protocols.

Fault Tolerance: Failure Models – Process Resilience – Reliable Client Server and Group Communications – Issues in Fault Tolerance, Dynamic voting protocols, Distributed Commit Protocols – Check-pointing and Recovery - Distributed Databases - Distributed Transactions

Module-V (08 Hrs)

Transactions and Concurrency Control: Introduction, Transactions, Nested Transactions, Locks, Optimistic Concurrency Control, Timestamp Ordering, Comparison of Methods for Concurrency Control.

Distributed Transactions: Introduction, Flat and Nested Distributed Transactions, Atomic Commit Protocols, Concurrency Control in Distributed Transactions, Distributed Deadlocks, Transaction Recovery.

Course Outcomes:

After the end of the course, students will be able to:

- Demonstrate knowledge of the basic elements and concepts related to distributed system technologies.
- Demonstrate knowledge of the core architectural aspects of distributed systems, design and implement distributed applications.
- Demonstrate knowledge of details the main underlying components of distributed systems (such as RPC, file systems).
- Use and apply important methods in distributed systems to support scalability and fault tolerance.
- Demonstrate experience in building large-scale distributed applications.

Text Books:

1. George Coulouris, Jean Dollimore, Tim Kindberg and Gordon Blair, Distributed Systems: Concepts and Design, Fifth Edition, Pearson Education, 2017.
2. Distributed Systems, Principles and Paradigms, Andrew S. Tanenbaum, Maarten Van Steen, 2nd Edition, PHI.

Reference Books:

1. Distributed Systems, An Algorithm Approach, Sukumar Ghosh, Chapman & Hall/CRC, Taylor & Francis Group, 2007.
2. Garg VK. Elements of distributed computing. John Wiley & Sons, 2002.