# KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY
## Deemed to be University
### BHUBANESWAR-751024
# School of Computer Engineering

# LESSON PLAN

**Course Title: Distributed Operating Systems (CS 30009)**
5th Semester B. Tech. (Department Elective)
Session: Autumn 2024: July to December 2024

| L | T | P | Total | Credit |
|---|---|---|-------|--------|
| 3 | 0 | 0 | 3 | 3 |

**Faculty**

Dr. NAMITA PANDA
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Chamber: F-215, Block-A, Campus – 15

**Course Objectives**

1. To understand the fundamentals of distributed systems
2. To acquire the basic concepts of shared memory architecture
3. To understand various implementation difficulties of distributed operating systems.
4. To understand transparency in distributed operating systems.

# Detailed Lesson Plan

Total No. of Lectures ≈ 38

No. of classes before Mid-semester ≈ 19

No. of Classes after Mid-semester ≈ 19

## UNIT – I: Fundamentals of Distributed Systems

| Lecture | Topics |
|---------|--------|
| 1 | Introduction to distributed systems, Goals of Distributed Systems. |
| 2 | Hardware Concepts – Bus-based Multiprocessors, Switched Multiprocessors, Bus-based Multicomputers, Switched Multicomputer. |
| 3 | Software Concepts – Network OS, True Distributed Systems, Multiprocessor Timesharing Systems. |
| 4 | System Architecture and Design Issues – Transparency, Flexibility, Reliability, Performance, Scalability. |

## UNIT II: Communication in Distributed Systems

| Lecture | Topics |
|---------|--------|
| 5 | Layered Protocols – ISO OSI Reference Model |
| 6 | Asynchronous Transfer Mode (ATM) Networks |
| 7 | The Client-Server Model - Clients and Servers, Addressing Process via Machine, Broadcasting and ASCII names Lookup |
| 8 | Blocking versus Nonblocking Primitives, Buffered versus Unbuffered Primitives |
| 9 | Reliable and Unreliable primitives, Message Passing (Implementing the Client-Server Model) |
| 10 | Remote Procedure Call (RPC)– Basic Operation, Parameter Passing, Dynamic Binding |
| 11 | RPC Semantics during different Failures – Server location, Message Lost, Client Crashes |
| 12 | RPC Performance Parameters – Protocol Selection, Acknowledgements, Critical Path, Copying, Timer Management |

## UNIT III: Synchronization and Processes

| Lecture | Topics |
|---------|--------|
| 13 | Clock Synchronization – Logical Clock versus Physical Clock |
| 14 | Clock Synchronization Algorithms – Cristian's Algorithm, The Berkeley Algorithm, Averaging Algorithms; Use of Synchronization Clocks |
| 15 | Mutual Exclusion Algorithms – Centralized, Distributed, Token Ring |
| 16 | Election Algorithms – A Bully Algorithm, A Ring Algorithm |
| 17 | Atomic Transactions & Modeling – Stable Storage, Transaction Primitives, Properties |
| 18 | Atomic Transaction Implementation – Private Workspace, Writeahead Log, Two-Phase Commit Protocol |
| 19 | Concurrency Control Algorithms in Atomic Transaction – Locking System, Optimistic Approach, Time stamps |
| | <div style="text-align:center">**Mid Semester**</div> |
| 20 | Deadlocks in Distributed Systems (Deadlock Detection and Prevention) |
| 21 | Process and Threads – Introduction, Usage, Implementing Thread in User Space and Kernel Space |
| 22 | Threads and RPC. System Models- The Workstation Model, Using Idle Workstations, The Processor Pool Model |
| 23 | Processor Allocation Algorithms – Graph-Theoretic, Centralized, Hierarchical, Sender-Initiated, Receiver-Initiated and Bidding |
| 24 | Scheduling in Distributed Systems |

**UNIT-IV: Consistency, Replication and Fault Tolerance**

| Lecture | Topics |
|---------|--------|

| | |
|---|---|
| 25 | ==Data-Centric Consistency Models== |
| ==26== | ==Client-Centric Consistency Models== |
| 27 | Replica Management, Consistency Protocols |
| 28 | Fault Tolerance – Component Faults, System Failures, |
| 29 | Fault Tolerance - Use of Redundancy, Active Replication, Use of Primary Backup |
| 30 | Process Resilience, Distributed Commit |
| 31 | Reliable Client-Server Communication |

## UNIT - V: Overview of Distributed Shared Memory (DSM)

| Lecture | Topics |
|---|---|
| 32 | Architecture – On-Chip Memory, Bus-Based Multiprocessors, Ring-Based Multiprocessors |
| 33 | Switched Multiprocessors, Directories, Caching |
| 34 | Protocols – Dash Protocols, NUMA Multiprocessors, NUMA Algorithms |
| 35 | Different Consistency Models – Strict, Sequential, Causal, PRAM, Processor, Weak, Release, and Entry Consistency |
| 36 | Page-based Distributed Shared Memory |
| 37 | Shared-Variable Distributed Shared Memory (Eg: Munin, Midway) |
| 38 | Object-based Distributed Shared Memory (Eg: Linda, Orca) |

## Course Outcomes

Upon completion of the course, the students will be able to:

CO1: Visualize the concept of Distributed Operating Systems

CO2: Enlist the communication techniques in Distributed Operating Systems

CO3: Learn the clock synchronous concepts and algorithms

CO4: Examine the distributed system that fulfills requirements concerning key distributed systems properties

CO5: Discuss distributed shared memory architectures and algorithms

CO6: Analyze the distributed file systems

## Activities

| Task | Marks |
|------|-------|
| **Before Mid-semester** | |
| Activity -1 : Test | 5 |
| Activity – 2 : Quiz | 5 |
| Activity – 3 : Assignment | 5 |
| **After Mid-semester** | |
| Activity – 4 : Test | 5 |
| Activity – 5 : Quiz | 5 |
| Activity – 6 : Assignment | 5 |

**Textbooks:**
1. Andrew S. Tanenbaum, "Distributed Operating Systems", Pearson Education, 1995.

**Reference Books:**
1. G. Coulouris, J. Dollimore, and T. Kindberg, "Distributed Systems: Concepts & Design", Pearson Publication, 4th

Edition,2005.
2. Pradeep K. Sinha, "Distributed Operating Systems Concepts and Design", PHI, 1998.