Banasthali Vidyapith
Department of Computer Science
Course Handout: MCA III Semester/ M.Sc. (CS) III Semester/ M.Tech. (CS) I Semester
July-December 2025

Date: 09-July-2025

Course Code: CS 419 **Course Name: Distributed Computing**

Credit Points: 4 **Max. Marks:** 100 (CA: 40 + ESA: 60)

Course Instructor: Vivek Purohit, Associate Professor (Computer Science)

Course Outcomes:
After successful completion of the course students will be able to:
CO 1 Understand the hardware and software concepts of distributed operating systems, various design issues like transparency, flexibility, etc., and communication and synchronization in distributed operating systems.
CO 2 Understand scheduling in distributed operating systems, fault tolerance, real-time distributed systems, and designing of distributed file systems.
CO 3 Understand the concept of design and implementation in the context of distributed operating systems.

Syllabus:

Section A

Distributed Operating System: Distributed Computing System Models, Issues in Design of Distributed Operating System, Message Passing, Remote Procedure Calls, Synchronization, Process Management, Resource Management, Distributed File Systems.

Section B

Distributed Algorithms: Introduction to Distributed Algorithms, Synchronous and Partial Synchronous Models, Algorithms in General Synchronous Leader Election (LCR Algorithm, HS Algorithm, A Simple Flooding Algorithm), Breadth First Search, Shortest Path, Minimum Spanning Tree, Maximal Independent Set, Distributed Consensus with Link and Process Failures. Asynchronous System Model, I/O Automata, Operations of Automata, Complexity Measures, Randomizations.

Section C

Asynchronous Shared Memory Model, Mutual Exclusion (Dijkstra's Mutual Exclusion Algorithm, Lockout-free Mutual Exclusion Algorithm, An Algorithm using Single-Writer Shared Register, Bakery Algorithm), Resource Allocation (Dining Philosophers Problem, Right-Left Dining Philosophers Algorithm, Randomized Dining Philosophers Algorithm), Consensus, Asynchronous Network Model (Send/ Receive Systems, Broadcast Systems, Multicast Systems), Basic Asynchronous Network Algorithms, Shared Memory V/s Networks.

Suggested Books:
R1. Sinha, P.K. (1998). *Distributed Operating Systems: Concepts and Design.* Prentice-Hall of India Private Limited.
R2. Tanenbaum, A.S. (2009). *Modern Operating Systems.* Pearson Education, Inc.
R3. Lynch, N.A. (1996). *Distributed Algorithms.* Morgan Kaufmann Publishers, Inc.
R4. Rumelhart, D. E., McClelland, J.L., & PDP Research Group. (1987). *Parallel Distributed P*rocessing (Vol. 1 & Vol. 2). Cambridge, MA: MIT Press.

Suggested E-Learning Material:
E1. Distributed Systems
https://nptel.ac.in/courses/106106168/
E2. Tanenbaum, A.S, & Van Steen, M. (2007). *Distributed Systems: Principles and Paradigms.* Prentice-Hall.
https://www.distributed-systems.net/index.php/books/distributed-systems-3rd-edition-2017/

Assessment Schedule:

Component	Marks	Submission/ Examination Date(s)	Allotment/ Syllabus
Assignment 1**	10	17 August, 2025	Topics shall be allotted in the class by 01 August, 2025
Periodical Test 1	10	29 August - 01 September, 2025*	Lecture No. 01 to 18
Assignment 2**	10	19 September, 2025	Topics shall be allotted in the class by 03 September, 2025
Periodical Test 2	10	12-16 October, 2025*	Lecture No. 19 to 40
End-Semester Examination	60	01-19 December, 2025*	Lecture No. 01 to 50 (Entire Syllabus)

* Subject to change.
** Assignment evaluation will be based on written document(s)/ test(s)/ viva-voce/ any other component(s) as decided by the instructor(s) on regular basis.

Lecture-Wise Plan:

Lecture Number	Topics to be Covered	Suggested Readings
	Section A	
01 – 03	Distributed Operating System: Distributed Computing System Models, Issues in Design of Distributed Operating System	R1/ R2/ E1/ E2
04 – 09	Message Passing, Desirable Features, Issues, Synchronization, Buffering, Multi-datagram Messages, Failure Handling, Group Communication	R1/ R2/ E1/ E2
10 – 12	Remote Procedure Calls, RPC Model, Transparency of RPC, Implementing RPC Mechanism, Stub Generation, RPC Messages, Server Management, Parameter-Passing Semantics, Call Semantics, Communication Protocols for RPCs	R1/ R2/ E2
13 – 14	Synchronization, Clock Synchronization, Event Ordering, Mutual Exclusion, Deadlock	R1/ R2/ E1/ E2
15 – 16	Process Management, Process Migration, Threads	R1/ R2/ E2
17 – 18	Resource Management, Task Management Approach, Load-Balancing Approach, Load-Sharing Approach	R1/ R2/ E2
19 – 20	Distributed File Systems, File Models, File-Accessing Models, File-Sharing Semantics, File-Caching Schemes, File Replication, Fault Tolerance, Atomic Transactions	R1/ R2/ E2
	Section B	
21 – 22	Introduction to Distributed Algorithms, Synchronous and Partial Synchronous Models	R3/ E1
23 – 25	Leader Election in a Synchronous Ring (LCR Algorithm, HS Algorithm), Leader Election in a General Synchronous Network (FloodMax Algorithm, OptFloodMax Algorithm)	R3/ E1
26 – 28	Breadth First Search (SynchBFS Algorithm), Shortest Paths (BellmanFord Algorithm), Maximal Independent Set (LubyMIS Algorithm)	R3/ E1
29	Distributed Consensus with Link Failures (RandomAttack Algorithm)	R3/ E1
30 – 32	Distributed Consensus with Process Failures (FloodSet Algorithm, OptFloodSet Algorithm, EIGStop Algorithm, EIGByz Algorithm, TurpinCoan Algorithm)	R3/ E1
33 – 35	Asynchronous System Model, I/ O Automata, Operations on Automata, Complexity Measures, Randomizations	R3
	Section C	
36	Asynchronous Shared Memory Model	R3/ E1
37 – 40	Mutual Exclusion, Dijkstra's Mutual Exclusion Algorithm (DijkstraME Algorithm), Lockout-Free Mutual Exclusion Algorithms (Peterson2P Algorithm, PetersonNP Algorithm), An Algorithm Using Single-Writer Shared Registers (BurnsME Algorithm), Backery/ Lamport's Algorithm	R3/ E1
41 – 42	Resource Allocation, Dining Philosophers Problem (WrongDP Algorithm), Right-Left Dining Philosophers Algorithm (RightLeftDP Algorithm), Randomized Dining Philosophers Algorithm (LehmannRabin Algorithm)	R3/ E1
43	Consensus	R3/ E1
44 – 46	Asynchronous Network Model, Send/Receive Systems, Broadcast Systems, Multicast Systems	R3
47 – 48	Basic Asynchronous Network Algorithms (AsynchLCR Algorithm, PetersonLeader Algorithm)	R3
49 – 50	Shared Memory v/s Networks, Transformations from the Shared Memory Model to the Network Model, Transformations from the Network Model to the Shared Memory Model	R3

Vivek Purohit