CVM UNIVERSITY
Aegis: Charutar Vidya Mandal (Estd.1945)

FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: **Bachelor of Technology (Computer Engineering)**

Semester: **V**

Course Code: **202045608**

Course Title: **Distributed Computing**

Course Group: **Professional Elective Course**

Course Objectives: This course provides the fundamental knowledge of the various aspects of Distributed Systems and Distributed Computing through the concepts of Interprocess and remote communication, distributed shared memory, synchronization and resource management and various distributed computing approaches to make students able to understand distributed system architecture.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		Total
Lecture	Tutorial	Practical		Internal	External	Internal	External	
3	0	2	4	50 / 18	50 / 17	25 / 9	25 / 9	150 / 53

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	**Fundamentals of Distributed Systems and Network Communication in Distributed Systems:** Definition and goals of a Distributed System, Types of Distributed Systems, Design issues in distributed systems, LAN and WAN technologies, OSI Model and Internet protocols, for Distributed systems, Client Server model & its implementation, remote procedure call and implementation issues	03
2	**Interprocess and Remote Communication** Message Passing and its features, IPC message format, IPC synchronization, Buffering, multi datagram messaging, process addressing techniques, failure handling, Formal Models for message passing systems, Broadcast and converge cast on a spanning tree, Flooding and building a spanning tree, Constructing a DFS spanning tree with and without a specified root, Introduction, RPC basics, RPC implementation, RPC Communication and Other issues, RMI basics, RMI Implementation. Case study: Sun RPC, Java RMI	07

3	**Distributed System synchronization and management** Clock synchronization, Logical clocks, Global state, Mutual exclusion, Election algorithms: Bully algorithm, Ring algorithm, Leader election in rings, anonymous rings, Asynchronous rings, synchronous rings, election in wireless networks, Deadlocks in Distributed systems, Deadlocks in Message communication, Resource management, Task management approach, Load balancing approach, Load sharing approach, Process Management, Process migration, threads, fault tolerance	**08**
4	**Distributed Shared Memory, naming and Distributed File Systems** Basic Concepts DSM and DFS (Distributed File Systems), Hardware DSM, Design and implementation issues in DSM systems, Heterogeneous and other DSM systems, Overview, System oriented names, Object locating mechanisms, Issues in designing human oriented names, Name caches, Naming and security, DNS	**05**
5	**Concepts of Distributed Computing** Distributed Computing System, Basic Algorithms in Message Passing System(Broadcast algorithm, Convergecast algorithm, A Flooding Algorithm, DFS Spanning Tree algorithm for specified root), Leader Election in Rings(LeLann-Chang-Roberts(LCR) algorithm, The Hirschberg and Sinclair(HS) algorithm),Distributed Computing Model, Causality & Logical Time, Size of Vector Clock, Matrix Clocks, Virtual Time and Physical Clock Synchronization	**08**
6	**Distributed Computing Approaches** Global State and Snapshot Recording Algorithms, Distributed Mutual Exclusion(Non-Token based Approach, Quorum Based Approach, Token Based Distributed Approach),Consensus and Agreement Algorithms, Deadlock Detection in Distributed Systems(path-pushing, edge chasing, diffusion computation and global state detection),Message Ordering and Group Communication, Self-Stabilization(Issues in the design of self-stabilizing algorithms and systems and Dijkstra's self-stabilizing token ring system).	**09**
	Total	**40**

List of Practicals / Tutorials:

1	Write a Program to implement Concurrent Echo Client Server Application.
2	Write a program for swapping variable values using the concept of IPC through thread programming in Java.
3	Write a program for remote procedure call (RPC chat server implementation).
4	Write a program for remote method invocation (RMI).
5	Write a program to increment a counter in shared memory.
6	Write a program to implement the state full server and stateless server.
7	Implement Network file system (NFS).
8	Study RPCgen protocol compiler and write a program to find a minimum of two numbers using RPCgen utility under Linux using command line arguments.
9	Program to implement non token based algorithm for Mutual Exclusion
10	Program to implement edge chasing distributed deadlock detection algorithm.
11	To Simulate the functioning of Lamport's Logical clock in 'c'.
12	To Simulate the functioning of Lamport's Vector clock in 'c'.

Reference Books:

1	Distributed Computing, Sunita Mahajan and Seema Shah, Oxford University Press
2	Sinha, P.K., 1998. Distributed operating systems: concepts and design. PHI Learning Pvt. Ltd..
3	Liu, M.L., 2003. Distributed computing: principles and applications. Pearson Education Inc..
4	Lynch, N.A., 1996. Distributed algorithms. Elsevier.
5	Distributed Computing: Principles, Algorithms, and Systems- Ajay D. Kshemkalyani and Mukesh Singhal
6	Distributed Computing: Fundamentals, Simulations and Advanced Topics-Hagit Attiya and Jennifer.

Supplementary learning Material:	
1	NPTEL - Swayam Courses: https://onlinecourses.nptel.ac.in/noc21_cs87/preview

Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Seminar/Poster Presentation
- Industrial/ Field visits
- Course Projects

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						**R**: Remembering; **U**: Understanding; **A**: Applying; **N**: Analyzing; **E**: Evaluating; **C**: Creating
R	**U**	**A**	**N**	**E**	**C**	
15%	25%	25%	15%	20%	--	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	To Understand fundamentals of Distributed systems and Networking,	**12**
CO-2	To Learn the concepts of various aspects of inter process and remote communication in DS	**21**
CO-3	To understand the concepts of various algorithms for synchronization and resource management for Distributed Systems and shared memory	**26**
CO-4	To understand the principles & basic concepts of the Distributed Computing Model.	**23**
CO-5	To learn various Distributed Computing Algorithms in detail.	**18**

Curriculum Revision:	
Version:	2.0
Drafted on (Month-Year):	June-2022
Last Reviewed on (Month-Year):	-
Next Review on (Month-Year):	June-2025