Bharatiya Vidya Bhavan's

Sardar Patel Institute of Technology

(Autonomous Institute Affiliated to University of Mumbai) Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058

Distributed Computing

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Distributed Computing	3	0	2	5	10	3	0	1	4
		Examination Scheme								
		Component		ISE		MSE		ESE		Total
CE301		Theory		15		15		45		75
		Laboratory		15		--		10		25

Pre-requisite Course Codes, if any.	
Course Objective:	
Course Outcomes (CO): ***At the End of the course students will be able to***	
CS301/CE301 .1	Understand the fundamental concepts and design principles of distributed systems.
CS301/CE301 .2	Analyze and apply synchronization techniques and algorithms in distributed environments.
CS301/CE301 .3	Evaluate consistency models and replication strategies for distributed data management.
CS301/CE301 .4	Design and assess distributed file systems and understand their real-world applications.
CS301/CE301 .5	Explore emerging trends and technologies in distributed computing.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS301/CE301 .1	3	2	2	2	1	-	-	-	-	-	-	-
CS301/CE301 .2	3	3	3	2	2	-	-	-	1	-	-	-
CS301/CE301 .3	3	3	3	2	2	-	-	-	1	-	-	-
CS301/CE301 .4	3	2	3	2	2	-	-	-	1	-	-	-
CS301/CE301 .5	3	2	2	2	2	-	-	-	1	-	-	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS301/CE301.1							
CS301/CE301.2							
CS301/CE301.3							
CS301/CE301.4							
CS301/CE301.5							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze √	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	**Introduction to Distributed Systems**		8
	1.1	Definition, Goals, Types of Distributed Computing Models, Issues in Distributed Systems.	T1,T2	
	1.2	Hardware Concepts, Software Concepts, The Client-Server Model, Positioning Middleware, Models of Middleware, Services offered by Middleware.	T1	
2	Title	**Communication in Distributed Systems**		10
	2.1	Interprocess Communication: Message passing, RPC, RMI, Message Oriented Communication: Persistence and synchronicity in communication, Message Oriented Transient and Persistent Communications sockets.	T1,T2	
	2.2	Desirable features of message passing, message structure, Issues in IPC by message passing, message synchronization, Buffering, Multi datagram message, failure handling, Group communication and multicast.	T1,T2	
3	Title	**Process and Clock Synchronization and Coordination**		10
	3.1	Introduction to Threads, Threads in Distributed Systems, Clients, Server, Code Migration: Approaches to Code Migration, Models, Migration and Local Resources.	T1	
	3.2	Clock Synchronization: Cristian's and Berkeley algorithms, Logical Clocks: Lamport's Timestamps, Vector Clocks, Mutual Exclusion: Token based, Non token based and Quorum based. Election Algorithms: Bully and Ring Algorithm.	T1,T2	
4	Title	**Consistency and Replication**		6
	4.1	Data-centric and client-centric consistency models, Replication strategies, quorum consensus, and consistency protocols.	T1,T2	
	4.2	Types of Failures and Replication Techniques, Fault Tolerance.	T1,T2	
5	Title	**Distributed File Systems & Case Studies**		8
	5.1	Design and implementation of DFS: NFS, AFS, HDFS, Google File System (GFS), Hadoop, Apache Kafka.	T1, R1,2,3, 4	
	5.2	Emerging trends: Blockchain, types of Blockchain, Bitcoin, High performance computoin, Microservices, Distributed AI & Machine Learning.	R1,2,3, 4	
6	Self Study	Cloud Computing, Edge Computing and Fog Computing, Need for Edge/Fog in IoT, Architectures and real-world applications, Open MPI.	R1,2,3, 4	6*
			Total	**42**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No	Title of the Experiment
1	Client-Server Communication using RPC or Java RMI
2	Implementation of Multithreading in Distributed System
3	Implementation of Clock Synchronization (logical/physical).
4	Implement Bully and Ring Election Algorithms
5	Implementation of data consistency and replication models
6	Implementation Load Balancing Algorithm.
7	Implementation a basic MapReduce job using Hadoop or Apache Spark
8	Simulate simple fault tolerance with primary-backup replication
9	MPI Collective Communication: Broadcast, Scatter, Gather
10	Parallel Matrix Multiplication using MPI

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Distributed Systems: Principles and Paradigms	2nd Edition	Andrew S. Tanenbaum, Maarten Van Steen	Pearson Education	2007
2	Distributed Operating Systems Concepts and Design	Second Edition	P. K. Sinha	PHI	2010

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Distributed Systems: Concepts and Design	5th Edition	George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair	Pearson	2012
2	Distributed Computing: Principles, Algorithms, and Systems	-	Ajay D. Kshemkalyani, Mukesh Singhal	Cambridge University Press	2008
3	Using MPI: Portable Parallel Programming with the Message-Passing Interface	2nd Edition	William Gropp, Ewing Lusk, Anthony Skjellum	MIT Press	1999
4	Distributed VOD Systems	First Edition	Sudhir D. & Bandu B.M	Research India Publication	2011