DISTRIBUTED SYSTEMS AND CLOUD COMPUTING

Code: CS31213CS	Course Type: Core	Semester: II
Evolution Scheme (TA-MSE-ESE): 20-30-100	Total Marks: 150	L-T-P (Credits): 3-0-0 (3)

Pre-Requisites: **NIL**

Course Objective: To understand the fundamental concepts of distributed and cloud computing, including communication models, synchronization, and system design principles, and to design, analyze, and evaluate reliable, secure, and high-performance distributed and cloud-based systems for real-world applications.

Course Outcomes: At the end of the course, students will be able to

CO-1	Analyze the fundamental concepts of distributed systems, including communication models, RPC mechanisms, and design challenges.
CO-2	Apply synchronization, process, and resource management techniques to design reliable distributed systems with fault tolerance, consistency, and recovery mechanisms.
CO-3	Analyze the fundamental principles and theoretical models of cloud computing
CO-4	Evaluate performance, security, and reliability of cloud-based systems in real-world scenarios

Course Articulation Matrix:

PO	PEO-1	PEO-2	PEO-3	PEO-4	PEO-5
CO-1	3	3	1	1	2
CO-2	3	3	2	1	3
CO-3	3	3	2	1	2
CO-4	3	3	2	2	3

1 - Slightly; 2 - Moderately; 3 – Substantially

Syllabus:

Unit-1: Fundamentals of Distributed Systems

Parallel and Distributed Systems, Message: passing systems versus shared memory systems, Synchronous versus asynchronous executions, Design issues and challenges of Distributed Computing. Remote Procedure Calls: RPC Model, RPC Messages. Marshalling, Server Management, Communication Protocols for RPCs, Client-Server Binding.

Unit-2: Distributed System Synchronization, Process and Resource Management Synchronization

Synchronization: Clock Synchronization and Event Ordering, Mutual Exclusion, Deadlock, Election Algorithms, Resource Management, Process Management: Process Migration, Threads. Distributed Transaction Consistency models- Replication

Unit-3: Cloud Computing Architecture and Virtualization

Cloud computing fundamentals: service models (IaaS, PaaS, SaaS), deployment models (public, private, hybrid), Virtualization technologies: hypervisors, containers, container

orchestration (Docker, Kubernetes), Resource management and scheduling in cloud environment, Data center design and energy-efficient computing, Serverless computing and Function-as-a-Service (FaaS)

Unit-4: Scalability, Fault Tolerance, and Security in Cloud Systems

Scalability techniques: load balancing, auto-scaling, elastic resource provisioning, Fault tolerance: replication, checkpointing, failure detection, recovery mechanisms, Monitoring and observability in distributed systems, Emerging trends: edge computing, fog computing, blockchain integration with cloud

Learning Resources:

Text Books:

1. P K Sinha, Distributed Operating System, PHI, IEEE Press.
2. George Coulouris, Jean Dollimore, Tim Kindberg, Distributed Systems: Concepts and Design, Pearson
3. Kai Hwang, Geoffrey Fox, Jack Dongarra, Distributed and Cloud Computing, Morgan Kaufmann

Reference Books:

1. Tanenbaum, "Distributed Systems: Principles and Paradigms", Pearson Education.
2. Kshemkalyani, Ajay D., Mukesh Singhal,"DistributedComputing:Principles, Algorithms, and Systems", Cambridge University Press.
3. Coulouris, Dollimore, Kindberg,"Distributed Systems-Concepts and Design", Pearson Education Asia.
4. Rajkumar Buyya et al., Cloud Computing: Principles and Paradigms, Wiley