Programme: M. Tech. (CSE)	Course Title: Distributed Systems			Course Code: CSE-0000
Type of Course: Program Elective	Prerequisites: NIL.			Total Contact Hours: 40
Year/Semester: 1/Odd	Lecture Hrs/Week: 3	Tutorial Hrs/Week: 0	Practical Hrs/Week: 0	Credits: 3

Learning Objectives and Overview:

The course aims to provide a basic understanding of concepts relating to distributed systems, such as, its architecture, communication methods, virtualization, synchronization, consistency and replication, fault tolerance and security. The course also encourage to recapitulate the basic knowledge of Operating Systems, Computer Networks, Data Structures and Algorithms.

Course outcomes (COs):

On completion of this course, the students will have the ability to:		Bloom's Level
CO-1	**Understand** the fundamental concepts associated with distributed systems.	2, 3
CO-2	**Describe** the communication models in distributed systems and **analyze** the concepts of scheduling and concurrency methods in such systems.	1, 4
CO-3	**Analyze** and **apply** the concepts of virtualization, naming, and synchronization in the implementation of distributed systems.	3, 4
CO-4	**Understand** and **apply** the concepts of consistency and replication in distributed transactions.	2, 4
CO-5	**Apply** various techniques to develop fault tolerant and secure systems and **Illustrate** the application areas of distributed systems and its evolution with time.	3, 4

Course Topics	Lecture Hours	
UNIT – I (Introduction and Architecture)		**4**
1.1 Definition of a distributed system, Goals, Types of distributed systems.	**1**	
1.2 System architectures, Architectures versus middleware, Self-management in distributed systems.	**3**	
UNIT – II (Communication)		**8**
2.1 Threads, Clients-Servers, Code migration.	**2**	
2.2 Remote method invocation, Message oriented communication, Stream oriented communication, Multicast communication.	**2**	
2.3 Concurrency models.	**2**	

2.4 Distributed and cluster scheduling.	**2**	
UNIT – III (Virtualization and Naming)		
3.1 OS virtualization, Process migration.	**2**	**8**
3.2 Container and VM migration.	**2**	
3.3 Names, Identifiers and addresses, Flat naming, Structured naming and Attribute based naming.	**4**	
UNIT-IV (Synchronization)		
4.1 Clock synchronization, Logical clocks, Vector clocks, Distributed snapshot.	**4**	**6**
4.2 Leader election, Distributed locks.	**2**	
UNIT-V (Consistency and Replication)		
5.1 Distributed transaction, Consistency in distributed systems, Data centric consistency models, Client centric consistency models.	**5**	**6**
5.2 Replica management.	**1**	
UNIT-VI (Fault Tolerance and Security)		
6.1 Byzantine Fault Tolerance, Consensus, Paxos, Raft.	**3**	**8**
6.2 Distributed system security, Secure channels, Access control, Security management.	**2**	
6.3 Case studies on different applications of Distributed Systems. (Distributed Web Applications, Edge computing, Web caching, Distributed file systems, xFS, HDFS etc.)	**3**	

Textbook References:
Text Book:

1. *M. van Steen and A.S. Tanenbaum, Distributed Systems, 3rd ed., distributed-systems.net, 2017.*

Reference books:

1. *George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems Concepts and Design", Pearson Publications, 5th Edition, 2013.*
2. *Ajay D. Kshemkalyani and Mukesh Singhal, "Distributed Computing: Principles, Algorithms and Systems", Cambridge University Press, 2011.*
3. *ML Liu, "Distributed Computing Principles & Applications", Pearson, 2013.*

Additional Resources:

1. Stanford University, Stanford School of Engineering, ***CS244b: Distributed Systems***-- Course Materials ***(https://www.scs.stanford.edu/22sp-cs244b/)***

Evaluation Method	
Item	**Weightage (%)**
Quiz	20
Assignment/Project	10
Mid Term	30
End Term	40

*Please note, as per the existing institute's attendance policy the student should have a minimum of 75% attendance. Students who fail to attend a minimum of 75% lectures will be debarred from the End Term/Final/Comprehensive examination.

CO and PO Correlation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**1**						**2**	**1**		**3**	**3**	**1**	**3**
CO2	**3**	**3**	**2**						**2**	**1**		**3**	**3**	**1**	**3**
CO3	**3**	**3**	**1**						**2**	**1**		**3**	**3**	**1**	**3**
CO4	**3**	**2**	**1**						**2**	**1**		**3**	**3**	**1**	**3**
CO5			**3**	**2**							**1**		**2**	**1**	

Last Updated On: July 27, 2022.

Updated By: Poulami Dalapati.

Approved By: