COURSE HANDOUT

DISTRIBUTED SYSTEMS

(MCSE 104)

M.Tech. CSE 1st Semester

ACADEMIC YEAR: 2024-25

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Course Code	Course Name	Course Type	Cd	L	T	P	Marks		
							External	Internal	Total
MCSE 104	Distributed Systems	Core	3	3	0	0	75	25	100

COURSE OUTCOMES

At the end of the course the student will be able to:	
CO104.1	Learn issues related to clock Synchronization and the need for global state in distributed systems when designing, implementing, and debugging distributed systems
CO104.2	Understand the significance of agreement, fault tolerance and recovery protocols in Distributed Systems.
CO104.3	Compare replication schemes with respect to performance, availability, and consistency concerns

Section-A

Unit-I

Introduction: Definition, Relation to computer system components, Motivation, Relation to parallel systems, Message-passing systems versus shared memory systems, Primitives for distributed communication, Synchronous versus asynchronous executions, Design issues and challenges. A model of distributed computations: A distributed program, A model of distributed executions, Models of communication networks, Global state, Cuts, Past and future cones of an event, Models of process communications. Logical Time: A framework for a system of logical clocks, Scalar time, Vector time, Physical clock synchronization: NTP.

(8 Hours)

Unit-II

Message Ordering & Snapshots: Message ordering paradigms, Asynchronous execution with synchronous communication, Synchronous program order on an asynchronous system, Group communication, Causal order (CO), Total order. Global state and snapshot recording algorithms: Introduction, System model and definitions, Snapshot algorithms for FIFO channels

(6 Hours)

Unit-III

Distributed Mutex & Deadlock: Distributed mutual exclusion algorithms: Introduction, Preliminaries, Lamport ‘s algorithm, Ricart-Agrawala algorithm, Maekawa ‘s algorithm, Suzuki–Kasami ‘s broadcast algorithm. Deadlock detection in distributed systems: Introduction, System model, Preliminaries, Models of deadlocks, Knapp ‘s classification, Algorithms for the single resource model, the AND model and the OR model.

(8 Hours)

Unit-IV

Recovery & Consensus: Check pointing and rollback recovery: Introduction, Background and definitions, Issues in failure recovery, Checkpoint-based recovery, Log-based rollback recovery, coordinated check pointing algorithm, Algorithm for asynchronous check pointing and recovery. Consensus and Agreement algorithms: Problem definition, Overview of results, Agreement in a failure–free system, Agreement in synchronous systems with failures.

(7 Hours)

Unit-V

P2P & Distributed Shared Memory: Peer-to-peer computing and overlay graphs: Introduction, Data indexing and overlays, Chord, Content addressable networks, Tapestry. Distributed shared memory: Abstraction and advantages, Memory consistency models, Shared memory Mutual Exclusion.

(6 Hours)

Text Books

S. No.	Name of the Books	Author	Publisher	Edition (Pub. Yr.)
1	Distributed Operating Systems: Concepts and Design	Pradeep K Sinha	Prentice Hall of India, 2007.	2007
2	Advanced concepts in operating systems.	Mukesh Singhal and Niranjan G. Shivaratri.	McGraw-Hill, Inc.,	1994
3	Distributed Systems: Principles and Paradigms	Tanenbaum A.S., Van Steen M.,	Pearson Education,	2nd edition, 2007

Reference Books

S. No.	Name of the Books	Author	Publisher	Edition (Pub. Yr.)
1	Distributed Computing, Principles and Applications	Liu M.L.,	Pearson Education	2004.

COURSE PLAN		
Unit-I		
S.No	**Topics**	**Recommended Books**
1	Introduction to Distributed Systems	Book 2, Ch.1
2	Distributed Systems vs. Parallel Systems	Book 1, Ch.1
3	Communication in Distributed Systems	Book 3, Ch.4
4	Design Issues and Challenges	Book 1, Ch.1
5	Models of Distributed Computations	Book 2, Ch 2
6	Models of Process Communication	Book 3, Ch 3
7	Logical Time in Distributed Systems	Book 3, Ch 6
8	Physical Clock Synchronization	Book 3, Ch 6
Unit-II		
13	Message Ordering Paradigms	Book 3, Ch.3
14	Asynchronous Execution with Synchronous Communication	Book 3, Ch.4
15	Synchronous Program Order on Asynchronous Systems	Book 3, Ch. 4
16	Group Communication and Causal Ordering	Book 3, Ch. 3
17	Total Order in Message Passing Systems	Book 3, Ch.3
18	Global State and Snapshot Recording Algorithms	
Unit-III		
19	Introduction to Distributed Mutual Exclusion Algorithms	Book 1, Ch. 6
20	Preliminaries of Mutual Exclusion in Distributed Systems	Book 1, Ch. 6
21	Lamport's Algorithm for Mutual Exclusion	Book 3, Ch.6
22	Ricart-Agrawala Algorithm	Book 3, Ch.6
23	Maekawa's Algorithm	Book 3, Ch.6
24	Suzuki-Kasami's Broadcast Algorithm	Book 3, Ch.6
25	Deadlock Detection in Distributed Systems	Book 1, Ch.6
Unit-IV		
31	Checkpointing and Rollback Recover	Book 1, Ch.
32	Background and Definitions in Failure Recovery	Book 1, Ch.15
33	Issues in Failure Recovery	Book 1, Ch.15
34	Checkpoint-based and Log-based Rollback Recovery	Book 2, Ch. 6
35	Coordinated Checkpointing Algorithm	Book 2, Ch. 6
36	Asynchronous Checkpointing and Recovery Algorithm	Book 2, Ch. 6
37	Consensus and Agreement Algorithms	Book 1, Ch. 15
Unit-V		
43	Peer-to-Peer Computing and Overlay Graphs	Book 2, Ch. 6
44	Introduction to Data Indexing and Overlays	Book 2, Ch. 1
45	Chord Protocol	Book 1, Ch. 32
46	Content Addressable Networks	Book 1, Ch. 32
47	Tapestry Overlay Network	Book 1, Ch. 31
48	Distributed Shared Memory Abstraction and Advantages	Book 1, Ch. 31
49	Memory Consistency Models and Shared Memory Mutual Exclusion	Book 1, Ch. 31

ADDITIONAL WEB RESOURCES

1.	**MOOC:** https://www.classcentral.com/course/coursera-distributed-database-systems-11170 **by Mohamed Sarwat** This course addresses the components of these systems, covering the following main topics: distributed database architectures, distributed data storage and indexing, distributed and parallel query processing/optimization, and concurrency control in distributed Parallel Database Systems.
2.	**NPTEL LINK:** https://nptel.ac.in/courses/106106168/ Lecture series on distributed systems by Dr. Rajiv Misra, Department of Computer Science and Engineering, IIT Patna.
3	**TUTORIAL LINK:**https://lecturenotes.in/subject/423/distributed-system-ds Comprehensive site containing lecture notes series on distributed systems Required for exam preparation.
4	**QUESTION BANK :**https://www.scribd.com/document/317963365/CS6601-DISTRIBUTED-SYSTEM-QUESTION-BANK

GRADING AND ASSESSMENT

- **Sessional Test**: 10 marks
- **Assignment**: 10 marks
- **Attendance**: 5 marks
- **Final Examination**: 75 marks

COURSE POLICIES

- **Attendance**: Minimum 75% attendance is mandatory to appear in the final examination of the course.
- **Academic Integrity**: MIET's academic integrity policies apply. Plagiarism will not be tolerated.
- **Late Submissions**: Assignments and projects must be submitted by the specified timelines.

FACULTY INFORMATION

- **Office Hours**

  Wednesday (10:00 AM - 12:00 PM)
  Friday (10:00 AM - 12:00 PM)

- **Contact Information**
  parul.cse@mietjammu.in