DISTRIBUTED SYSTEM AND APPLICATION DEVELOPMENT (Minor Elective-II)

Semester II (Computer Engineering)

SUB CODE: MECE205-A

Teaching Scheme (Credits and Hours)

Teaching scheme				Total Credit	Evaluation Scheme					
L	T	P	Total		Theory		Mid Sem Exam	CIA	Pract.	Total
Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	Marks
03	00	02	05	04	3	70	30	20	30	150

LEARNING OBJECTIVES:

The objective of this course is to introduce students to the following concepts.

- Describe the steps and algorithms used by load balancing concept in distributed system.
- Recognize the different failure models and communication reliability for client – server’s security concept.
- Discuss the effectiveness of recovery methods for concurrency control techniques.
- Explain the impact of event ordering, mutual exclusion and deadlock methodology on synchronization concept.

OUTLINE OF THE COURSE:

Unit No	Topics
1	Fundamentals of Distributed Systems
2	Distributed Shared Memory
3	Synchronization
4	Transaction and Concurrency Control
5	Consistency and replication
6	Distributed File System and Resource Management
7	Fault Tolerance and Security

Total hours (Theory): 45

Total hours (Practical): 30

Total hours: 75

DETAILED SYLLABUS:

Sr. No	Topic	Lecture Hours	Weight age (%)
1	**Fundamentals of Distributed Systems** • Distributed System Design Goals • Distributed Computing System Models • Challenges, Examples of Distributed Systems • Inter Process Communication • External Data Representation and Marshaling • Client Server Communication, Group communication • Case Study: SUN RPC	06	10
2	**Distributed Shared Memory** • Design and Implementation Issues • Architecture of Distributed Shared Memory • Granularity, Structure of Shared Memory Space • Strict Consistency Model, Sequential Consistency Model • Causal Consistency Model • Pipelined Random-Access Memory Consistency Model • Processor Consistency Model, Weak Consistency Model • Release Consistency Model • Munin: A Release Consistent DSM System • Replacement Strategy, Thrashing • Heterogonous Distributed Shared Memory • Advantages of Distributed Shared Memory	06	15
3	**Synchronization** • Clock Synchronization, Drifting of clocks • Clock Synchronization Algorithms • Event Ordering • Happened Before Relation, Logical Clocks • Mutual Exclusion • Centralized Approach, Distributed Approach • Token Passing Approach • Deadlock • Deadlock Modeling, Handling Deadlocks in Distributed System • Multicast Communication, Ordered Multicast **Election Algorithms:** • Bully Algorithm • A Ring Algorithm	06	15
4	**Transaction and Concurrency Control** • Nested Transactions	10	20

	• Locks • Optimistic Concurrency Control • Time Stamp Ordering • Flat and Distributed Transactions • Atomic Commit Protocols • Concurrency Control in Distributed Transactions • Distributed Deadlocks • Transaction recovery		
5	**Consistency and Replication** • Reasons for Replication • Data Centric Consistency Models • Continuous Consistency • Consistent Ordering of Operations • Client Centric Consistency Models • Consistency Protocols • Transactions with Replicated Data	06	15
6	**Resource Management and Distributed File Systems** • Features of a good scheduling Algorithm, Task Assignment Approach • Load Balancing And Load Sharing Approach • Process Migration • Desirable Features of a Good Distributed File System • File Models • File Accessing Models • Name Services and Domain Name System • File Sharing Semantics, File Caching Schemes • File Service Architecture, File Replication • Fault Tolerance, Case study: DCE Distributed file Service	05	10
7	**Fault Tolerance and Security** • Failure Models • Process Resilience • Reliable Communication (Client-Server, Group) • Distributed Commit • Recovery • Security Techniques • Cryptography, Authentication, Access Control • Digital Signature, Design Principles	06	15

INSTRUCTIONAL METHOD AND PEDAGOGY (Continuous Internal Assessment (CIA) Scheme)

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lecture and laboratory which carries 10 marks in overall evaluation.
- One internal exam will be conducted as a part of internal theory evaluation.
- Assignments based on the course content will be given to the students for each unit and will be evaluated at regular interval evaluation.
- Surprise tests/Quizzes/Seminar/tutorial will be conducted having a share of five marks in the overall internal evaluation.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Experiments shall be performed in the laboratory related to course contents.

STUDENTS LEARNING OUTCOMES:

On successful completion of the course, the student will:

- Be able to check the correctness of Synchronization concepts including event ordering, mutual exclusion and deadlock methodology.
- Be able to solve concurrency control techniques using the locks, time stamp ordering and transaction recovery methods.
- Become familiar with a variety of Load balancing algorithms and their performance characteristics and be able to choose the best one under a variety of requirements.
- Explain the Distributed file system and their resource management. Explain File service architecture with file replication and fault tolerance methods.

- Be able to use the different failure models, Reliable communication (client –server, group) to understand a security concept.
- Become familiar with the Distributed shared memory’s design and their implementation issues.

TEXT BOOKS:

1. Distributed Systems by George Coulouris, Pearson Education
2. Distributed Systems Principles and Paradigms by Andrew Tanenbaum, PHI
3. Distributed Operating Systems by P. K. Sinha, PHI

REFERENCE BOOKS:

1. Gerald Tel, "Distributed Algorithms", Cambridge University Press
2. Distributed Computing: concepts and Applications by M. L. Liu
3. Java Network Programming & Distributed Computing by David Reilly, Michael Reilly
4. Distributed systems by Sape J. Mullender

5. Distributed computing –principles, algorithms and systems by Ajay D. Kshemkalyani and Mukesh Singhal
6. Various research papers in reputed journals.

LIST OF PRACTICALS:

Sr. No	Name of Experiment
1	Calculate CPU load for your machine and identify the state of your machine
2	Get CPU load of other machine in the network.
3	To implement RPC
4	To implement concurrent client server application
5	To implement concurrent daytime client server application
6	Write a program to create CORBA based client server application
7	Write a program to increment counter in shared memory
8	Write a program to monitor SOAP request and response packet
9	Write a program to solve produce-consumer problem
10	Write a program to solve Dining Philosopher problem
11	Simulate Lamport’s Bakery Algorithm for distributed mutual exclusion.