GUJARAT TECHNOLOGICAL UNIVERSITY

COMPUTER ENGINEERING (SOFTWARE ENGINEERING) (02)
DISTRIBUTED COMPUTING AND APPLICATIONS
SUBJECT CODE: 2720207
SEMESTER: II

Type of course: Distributed computing and Application

Prerequisite: fundamentals of Operating System and computer network

Rationale: The most of the system are distributed systems and while developing such systems pause challenges such as heterogeneity of their components, openness (which allows components to be added or replaced), security, scalability – the ability to work well when the load or the number of users increases – failure handling, concurrency of components, transparency and providing quality of service . This course enables to understand these concepts and help in designing and developing distributed applications.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	ESE (V)		PA (I)		
						ESE	OEP	PA	RP	
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Introduction to Distributed Computing: Definition, Relation to parallel systems, synchronous vs asynchronous execution, design issues and challenges. A Model of Distributed Computations : A Model of distributed executions, Models of communication networks, Global state of distributed system, Models of process communication.	2	10
2	Network programming with sockets and streams	3	10
3	Message Passing: Inter process Communication, Desirable Features of Good Message-Passing Systems, Issues in IPC by Message, Synchronization, Buffering, Multidatagram Messages, Encoding and Decoding of Message Data, Process Addressing, Failure Handling, Group Communication. Remote Procedure Calls: The RPC Model, Transparency of RPC, Implementing RPC Mechanism, Stub Generation, RPC Messages, Marshaling. Arguments and Results, Server Management, Communication Protocols for RPCs, Complicated RPCs, Client-Server Binding, Exception Handling, Security, Some Special Types of RPCs, Lightweight RPC, Optimization for Better Performance.	6	15
4	Distributed Objects and Middleware Remote Method Invocation : Remote Method Invocation – Internet-Inter ORB Protocol Object Persistence and Object Serialization, Object Brokers, Message-Oriented Middleware	4	10
5	Distributed Shared Memory: Design and Implementation issues of DSM, Granularity, Structure of Shared memory Space, Consistency Models, replacement Strategy, Thrashing, Other Approaches to DSM,	4	10

	Advantages of DSM.		
6	Synchronization: Clock Synchronization, Event Ordering, Mutual Exclusion, Election Algorithms.	4	10
7	Resource and Process Management : Desirable Features of a good global scheduling algorithm, Task assignment approach, Load Balancing approach, Load Sharing Approach, Process Migration, Threads, Processor allocation, Real time distributed Systems.	4	10
8	Distributed multimedia systems – characteristics of multimedia data, quality of service management, resource management, stream adoption, case studt – Bit torrent	4	5
9	Concurrency, co-ordination and distributed transactions Ordering of events. Two-phase commit protocol. Consensus.	3	10
10	Security in distributed computing and application: Security threats, security mechanism, security policies, case study of Globus security architecture,	2	5
11	Introduction to XML, APIs for XML Processing. Enterprise Application Integration, Web Technologies, Web services: Concepts, Protocols: SOAP, WSDL, UDDI, Development of Web services.	6	15

Reference Books:
1. Distributed Computing – Concepts and Applications” by M. L. Liu, published by Addison-Wesley, Inc.
2. Distributed Systems Concepts and Design Fourth Edition George Coulouris, Jean Dollimore and Tim Kindberg, Addison-Wesley Inc./Pearson Education
3. Distributed OS by Pradeep K. Sinha (PHI)
4. Tanenbaum S. Maarten V.S.: Distributed Systems Principles and Paradigms, (Pearson Education)
5. Java in Distributed System, Marko Boger, John Wiley and Sons Ltd.
6. Java Network Programming and Distributed Computing, David Reilly and Michael Reilly, Addison-Wesley
7. Web Services, Gustavo Alonso, Fabio Casati, Harumi Kuno, Vijay Machiraju, Springer Verlag “Developing EJB Components”, Pravin Tulachand, published by Sun Microsystems

Course Outcome:
After learning the course the students should be able to:

1. Analyze software components of distributed computing systems.
2. Integrate OS and programming language concepts to solve/implement the (distributed) components of the systems.
3. Develop suites of networking protocols for implementing the communicating components

List of Experiments:

1. Develop a networking application in C/C++ through Socket programming.
2. Develop a networking application in C/C++ through Socket programming in java
3. Study Amoeba multicast protocol.
4. Implement RPC Programming
5. Implement distributed telephone directory using JavaRMI Programming. Implement concurrency control to distributed telephone directory.
6. Implementing election algorithm for synchronization
7. Implement Task assignment and load balancing scheme
8. Implement MPI
9. Implement two phase commit protocol

10. Study the design of a Gnutella client.
11. Develop distributed enterprise application
12. Design web service in java and .NET
13. Install Hadoop and implement a program to make use of map-reduce model. (Can be given as a mini project).
14. Install Globus toolkit and implement any program on it.

Open Ended Problems:
- Find issues in existing distributed architecture and try to propose solutions for the same.
- A typical distributed computing environment consists of several processing units which communicate through some underlying multi-hop network. The network is usually modeled after a graph, possibly weighted, where nodes represent the processing units and the edges the communication links. The nodes communicate by exchanging messages in the form of packets. *Routing* is the task of selecting the paths that the packets will follow in the network. Ideally the selected paths should have small *congestion*, that is, the maximum number of paths crossing any edge should be small, and the paths should have small *stretch*, that is, the ratio between the selected path and the respective shortest path should be as small as possible. *Oblivious* routing is a type of distributed routing suitable for dynamic packet arrivals. In oblivious routing, the path for a newly injected packet is selected in a way that it is not affected by the path choices of the other packets in the network. Design a scheme in which congestion and stretch can be optimized simultaneously. [http://www.cs.yale.edu/homes/aspnes/papers/beatcs-column-2006.pdf]
- There are two existing systems- an ordering system and a warehouse system. The ordering system handles billing customers and fulfilling orders. The warehouse system tracks inventory and sends shipments. Currently, each night, orders are printed from the ordering system and faxed to the warehouse, where they are checked to see if they have any inventory. If they are, they are fulfilled. If not, they get put on hold and the warehouse calls the sales rep to have them update the ordering system to mark the order "on hold" • until the product comes in. Make the ordering system and warehouse system communicate via web services.

Major Equipment:

- computer, internet connection and required

List of Open Source Software/learning website:

1. c, java, visual studio, hadoop, globus toolkit
2. http://www.cdk4.net/wo/additional/courses.html
3. http://www.cs.yale.edu/homes/aspnes/papers/beatcs-column-2006.pdf

Review Presentation(RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.