PONDICHERRY ENGINEERING COLLEGE, PUDUCHERRY – 605 014

CURRICULUM AND SYLLABI FOR AUTONOMOUS STREAM

M.TECH. (DISTRIBUTED SYSTEMS) COURSES

(FOR STUDENTS ADMITTED FROM ACADEMIC YEAR 2015-16 ONWARDS)

CURRICULUM

I SEMESTER

Subject Code	Subjects	Category	Periods			Marks			Credits
			L	T	P	CA	SE	TM	
CS151	Design of Distributed Systems	TY	3	1	-	40	60	100	4
CS152	High Performance Networks	TY	3	1	-	40	60	100	4
CS153	Distributed Database Management Systems	TY	3	1	-	40	60	100	4
CS154	Parallel Computing	TY	3	1	-	40	60	100	4
	Elective-I	TY	-	-	-	40	60	100	4
	Elective-II	TY	-	-	-	40	60	100	4
CS155	Advanced Software Laboratory-I	LB	-	-	3	60	40	100	2
Total Credits									**26**

II SEMESTER

Subject Code	Subjects	Category	Periods			Marks			Credits
			L	T	P	CA	SE	TM	
CS156	Cloud Computing	TY	3	1	-	40	60	100	4
CS157	Service Oriented Architecture and Web Services	TCM	3	-	2	50	50	100	4
	Elective-III	TY	-	-	-	40	60	100	4
	Elective-IV	TY	-	-	-	40	60	100	4
	Elective-V	TY	-	-	-	40	60	100	4
	Elective-VI	TY	-	-	-	40	60	100	4
CS158	Advance Software Laboratory-II	LB	-	-	3	60	40	100	2
CS159	Research Methodology	PR	-	-	3	100	-	100	1
Total Credits									**27**

SEMESTER-III

Subject Code	Subjects	Category	Periods			Marks			Credits
			L	T	P	CA	SE	TM	
CS160	Project Phase I	PR	-	-	-	150	150	300	9
Total Credits									**9**

SEMESTER-IV

Subject Code	Subjects	Category	Periods			Marks			Credits
			L	T	P	CA	SE	TM	
CS161	Project Phase II	PR	-	-	-	200	200	400	14
	Professional Development Courses	PR	-	-	-	200	-	200	2
Total Credits									**16**

A representative list of *Professional Development Courses* is given below:

a) Industrial Training (*Limited to one credit*)
b) Specific Field Knowledge Training
c) Seminar related with directed study
d) Paper Publication in SCI Journals(*Limited to one credit*)

#CA - Continuous Assessment, SE - Semester Examination, TM - Total Marks
*TY -Theory, TCM - Theory with a Mini Project, LB – Laboratory, PR - Practice

LIST OF ELECTIVES

Sl.No.	Subject Code	Subjects	Category
1.	**CSE51**	Mobile Computing Systems	TY
2.	**CSE52**	Information Retrieval Techniques	TY
3.	**CSE53**	Advanced Distributed System Architectures	TY
4.	**CSE54**	Machine Learning	TY
5.	**CSE55**	Agent Technology	TY
6.	**CSE56**	Optical Communication Networks	TY
7.	**CSE57**	Software Architecture	TY
8.	**CSE58**	Distributed Algorithms	TY
9.	**CSE59**	Data Mining and Warehousing Techniques	TY
10.	**CSE60**	Multi core Programming	TY
11.	**CSE61**	Ad hoc and Sensor Networks	TY
12.	**CSE62**	Network Management Systems	TY
13.	**CSE63**	Search Engine Optimization	TY
14.	**CSE64**	Text Data Mining	TY
15.	**CSE65**	Social Network Analytics	TY
16.	**CSE66**	Geographical Information System	TY
17.	**CSE67**	Internals of Operating System	TY
18.	**CSE68**	Distributed System Security	TY
19.	**CSE69**	Ethical Hacking	TY
20.	**CSE70**	Embedded Systems	TY

SYLLABUS (Core Subjects)

Department : Computer Science and Engineering		**Programme :** M.Tech. (Distributed Systems)						
Semester : One		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CS151	Design of Distributed Systems	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To introduce the Architecture, and types and design issues of Distributed Systems • To Learn the Fundamental Principles of Distributed Operating Systems • To Learn the Design of Distributed Fault Tolerant Systems							
Outcome	On successful completion of the course, students will be able to: • Design Middleware Components for Distributed Systems • Create a Distributed System through the integration of Heterogeneous Applications and Web services • Design of Fault Tolerant Distributed Systems							

UNIT – I	**Distributed Systems Architecture, Types and Remote Procedure Call**	**Hours: 09**

Introduction – Examples of Distributed Systems – Resource Sharing and the Web –Challenges- System Models - Introduction – Architectural Models – Functional Models - Characterization of Distributed Systems – Client-Server Communication – Distributed Objects and Remote Invocation – Communication Between Distributed Objects – Remote Procedure Call – Events and Notifications

UNIT – II	**Distributed Operating Systems**	**Hours: 09**

Introduction – Issues – Communication Primitives – Inherent Limitations - Lamport's Logical Clock; Vector Clock; Causal Ordering; Global State; Cuts; Termination Detection. Distributed Mutual Exclusion – Non-Token Based Algorithms – Lamport's Algorithm - Token-Based Algorithms – Suzuki-Kasami's Broadcast Algorithm – Distributed Deadlock Detection – Issues – Centralized Deadlock-Detection Algorithms - Distributed Deadlock-Detection Algorithms. Agreement Protocols – Classification - Solutions –Applications.

UNIT – III	**Distributed Resource Management**	**Hours: 09**

Introduction - Distributed File systems – Architecture – Mechanisms – Design Issues – Distributed Shared Memory – Architecture – Algorithm – Protocols – Design Issues. Distributed Scheduling – Issues – Components – Algorithms

UNIT – IV	**Failure Recovery and Fault Tolerance**	**Hours: 09**

Recovery – Introduction – basic concepts – Classification of Failures – Backward and Forward Error Recovery – Recovery in Concurrent Systems –Synchronous and Asynchronous Check-pointing and Recovery - Fault Tolerance – Introduction – Commit Protocols – Voting protocols – Dynamic Voting protocols – Dynamic Voting Reassignment Protocols – Failure Resilient processes – Reliable Communication

UNIT – V	**Naming, Security and Real Time Operating System**	**Hours: 09**

Introduction – Features of Good Naming System – Basic Concepts – System-Oriented Names – Object Locating Mechanisms – Issues in Designing Human-Oriented Names - Name Caches - Naming and Security. Security in Distributed Systems – Introduction – Cryptography – Secure Channels – Access Control – Security Management – Introduction to Real Time Operating System – Design Issues in Real-Time Distributed Systems – Real-time Scheduling

Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**	**Total Hours: 60**

Text Books:

1. Mukesh Singhal, and Niranjan Shivratri, Distributed Operating System. New Delhi: Tata McGraw Hill, Seventh Reprint, 2007
2. Andrew S. Tanenbaum, Maarten Van Steen, Distributed Systems Principles And Paradigms , Pearson Prentice Hall, Second Edition, 2007.

Reference Books:

1. George Coulouris, Jean Dollimore and Tim Kindberg, Distributed Systems Concepts and Design, Pearson Education, 2009
2. Sunita Mahajan and Seema Shah, Distributed Computing , Oxford University Press, Second Edition, 2011

Websites :

1. http://nptel.ac.in

Department : Computer Science and Engineering		**Programme :** M.Tech. (Distributed Systems)						
Semester : One		**Category :** TY						
Subject Code	**Course Name**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CS152	High Performance Networks	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To introduce the concepts, techniques and applications of Computer Networks. • To educate about layered communication architecture, routing algorithms, congestion control algorithms. • To give ideas and insights on important design issues associated with computer networks.							
Outcome	At the end of the course the students will be able to: • Understand the advanced topics in the field of computer networks • Gain knowledge about routing, switching and network configuration management.							
UNIT – I	**Introduction to Networks**							**Hours: 09**
Introduction to computer networks(Definition, Types, Topology, Applications) - OSI/ISO model – Introduction to high speed networks - High speed LANs – Fast Ethernet - Switched Fast Ethernet - Gigabit Ethernet – ISDN – B-ISDN – FDDI, Frame relay - operations and layers.								
UNIT – II	**SONET and ATM**							**Hours: 09**
Introduction to SONET – SONET/SDH Layers – SONET Frame Structure – SONET Physical Layer. Introduction ATM – Cell format and Switching Principles – Protocol Architecture – Service categories. TCP/IP protocol Suite – IP Packet Header – TCP packet header – User services – Protocol Operation – Connection Establishment – UDP.								
UNIT – III	**Congestion Control and Traffic Management**							**Hours: 09**
Congestion control in Data Networks and Internets – Effects of Congestion – Congestion Control in Packet Switched Networks. Frame relay Congestion Control – Traffic rate Management – Congestion Avoidance. ATM Traffic and Congestion Control – Attributes – Traffic Management Framework – Traffic Control – ABR Traffic Management. TCP Traffic Control – Flow Control – TCP Congestion Control – Timer Management – Window Management.								
UNIT – IV	**QoS and Introduction to Cisco**							**Hours: 09**
Introduction to Quality of Service - Integrated Services – Differentiated Services – Protocols for QoS support - Resource Reservation (RSVP) – Multiprotocol Label Switching (MPLS) – Real-Time Transport Protocol (RTP). Multimedia services – Transmission of multimedia over the internet – IP multicasting – VOIP. Introduction to the Cisco IOS – Cisco user interface – Router and Switch Administrative function – Router interface – Configuration management.								
UNIT – V	**Optical Networks**							**Hours: 09**
Introduction to Optical networks – Wavelength division multiplexing (WDM) – Introduction to broadcast-and-select networks - Switch architectures - channel accessing – Wavelength routed networks – Switch architectures - Routing and wavelength assignment – virtual topology design– IP over SONET over ATM over WDM – IP over ATM over WDM – IP over WDM.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**			**Total Hours: 60**			

Text Books:

1. William Stallings, High-Speed Networks and Internets, performance and Quality and Service , 2nd Edition, Pearson Education, 2002.
2. Todd Lammle, Sybex, CCNA Intro – Study Guide .
3. Dayanand Ambawade, Deven shah, MahendraMehra, Advance Computer Network, Wiley India, 2011.
4. Rajiv Ramaswami and Kumar N. Sivarajan, Optical Networks: A Practical Perspective , 2nd Edition, Morgan Kaufmann (Elsevier Indian Edition), 2004

Reference Books:

1. Fred Halsall, Multimedia Communications: Applications, Protocols and Standards, Pearson Education Asia, 2001.
2. C.Siva Ram Murthy and Mohan Gurusamy, WDM Optical Networks: Concepts, Design and Algorithms, PHI, 2002.
3. Laon-Garcia and Widjaja, Communication Networks: Fundamental Concepts and key Architectures, Tata McGrawHill, 2000.
4. Behrouz A. Forouzan, Data Communications and Networking , 2nd Edition, Tata McGraw-Hill, 2000.

Websites:
1. http://gonda.nic.in/swangonda/pdf/ccna1.pdf

Department : Computer Science and Engineering		**Programme :** M.Tech. (Distributed Systems)						
Semester : One		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CS153	Distributed Database Management Systems	3	1	-	4	40	60	100

Prerequisite	-
Objectives	• Understand the need for the Distributed Database Systems. • Knowledge on Distributed Database Architecture. • Need to get the knowledge regarding different Database paradigms like Web Data Management, Parallel Databases etc.,
Outcome	On successful completion of the course students will be able to: • Design the applications that includes Distributed Databases. • Perform Distributed Query Processing and Optimization. • Have knowledge on Integrity Control.

UNIT – I	**Introduction of DDBMS**	**Hours: 09**

Distributed Data Processing – Data Delivery Alternatives – Challenges of DDBSs – Design Issues – Distributed DBMS Architecture – Overview of Relational DBMS – Review of Computer Networks – Distributed Database Design – Top Down Design Process- Distribution Design Issues – Fragmentation – Allocation – Data Directory – Database Integration – Bottom Up Design Methodology – Schema Matching – Schema Integration – Schema Mapping – Data Cleaning.

UNIT – II	**Data and Access Control**	**Hours: 09**

View Management – Data Security – Semantic Integrity Control – Overview of Query Processing – Query Processing Problem – Objectives of Query Processing – Complexity of Relational Algebra Operations – Characterization of Query Processors – Layers of Query Processing – Query Decomposition and Data Localization – Query Decomposition – Localization of Distributed Data.

UNIT – III	**Optimization of Queries and Transaction Management**	**Hours: 09**

Query Optimization – Centralized Query Optimization – Join Ordering in Distributed Queries – Distributed Query Optimization – Multidatabase Query Processing – Issues in Multidatabase Query Processing - Multidatabase Query Processing Architecture – Query Rewriting Using Views – Query Optimization and Execution – Query Translation and Execution – Introduction to Transaction Management – Definition of a Transaction – Properties of Transactions – Types of Transactions – Architecture Revisited.

UNIT – IV	**Distributed Concurrency Control & Replication**	**Hours: 09**

Serializability theory – Taxonomy of Concurrency Control Mechanisms – Locking based Concurrency Control Algorithms – Timestamp based Concurrency Control Algorithms – Optimistic Concurrency Control Algorithms – Deadlock Management – "Relaxed" Concurrency Control – Distributed DBMS Reliability – Reliability concepts and Measures – Failures in Distributed DBMS – Local Reliability Protocols – Distributed Reliability Protocols – Dealing with Site Failures – Network Partitioning – Architectural Considerations – Data Replication – Consistency of Replicated Databases – Update Management Strategies – Replication Protocols – Group Communication – Replication and Failures – Replication Mediator Service.

UNIT – V	**Database Systems – Various Models**	**Hours: 09**

Parallel Database System Architectures – Parallel Data Placement – Parallel Query Processing – Load Balancing – Database Clusters – Distributed Object Database Management – Fundamental Object Concepts and Object Models – Object Distributed Design – Architectural Issues – Object Management – Distributed Object Storage – Object Query Processing – Transaction Management - Web Data Management – Web Graph Management - Web Search - Web Querying – Distributed XML Processing.

Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**	**Total Hours: 60**

Text Books:

1. M.Tamer Ozsu, Patrick Valduriez, Principles of Distributed Database Systems , Springer, 2011

Reference Books:

1. Chhandra Ray, Distributed Database Systems , Pearson Education India, 2012
2. Stefano Ceri ,Giuseppe Pelagatti , Distributed Databases: Principles and Systems , McGraw Hill Education, 2008

Websites:

1. http://databasemanagement.wikia.com/

2. http://docs.oracle.com/
3. http://www.odbms.org/

Department : Computer Science and Engineering		**Programme :** M.Tech. (Distributed Systems)						
Semester : One		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CS154	Parallel Computing	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To understand the architecture of parallel systems and identify the scope for parallelism in present day's processors. • To understand the various parallel programming models and the challenges involved in parallel programming and learn the parallel programming techniques with OpenMP and MPI • To study the complexity behind parallel algorithms							
Outcome	At the end of the course the students will be able to: • Acquire the skills to implement software effectively and efficiently on parallel hardware platforms • Have a keen knowledge in multithreading techniques							
UNIT – I	**Introduction**					**Hours: 09**		
Need of high speed computing – increase the speed of computers – history of parallel computers and recent parallel computers; solving problems in parallel – temporal parallelism – data parallelism – comparison of temporal and data parallel processing – data parallel processing with specialized processors – inter-task dependency- The need for parallel computers - models of computation - analyzing algorithms –expressing algorithms.								
UNIT – II	**Parallel Algorithm Design and Communication Operations**					**Hours: 09**		
Parallel Programming Platforms: Trends in microprocessor architectures - limitations of memory system performance – parallel computing platforms – communication costs in parallel machines – routing mechanisms for interconnection networks. Principles of Parallel Algorithm Design: Preliminaries – decomposition techniques – characteristics of tasks and interactions – mapping techniques for load balancing – methods for containing interaction overheads – parallel algorithm models. Basic Communication Operations: One-to-all broadcast and all-to-one reduction – all-to-all broadcast reduction – all-reduce and prefix-sum operations – scatter and gather – all-to-all personalized communication – circular shift – improving the speed of some communication operations.								
UNIT – III	**Parallel Programming Models**					**Hours: 09**		
Analytical Modeling of Parallel Programs: Sources of overhead in parallel programs – performance metrics for parallel systems – scalability of parallel systems – minimum execution time and minimum cost-optimal execution time. Programming using the Message-Passing Paradigm: principles of message-passing programming – the building blocks – MPI – topologies and embedding – overlapping communication with computation – collective communication and computation operations – groups and communicators. Programming Shared Address Space Platforms: Thread basics – synchronization primitives in Pthreads – controlling thread and synchronization attributes – composite synchronization constructs – tips for designing asynchronous programs – OpenMP.								
UNIT – IV	**Parallel Algorithms**					**Hours: 09**		
Dense Matrix Algorithms: Matrix-vector multiplication – matrix-matrix multiplication – solving a system of linear equations – FFT. Sorting: Issues in sorting on parallel computers – sorting networks – bubble sort and its variants – Quicksort – bucket and sample sort – other sorting algorithms. Graph Algorithms: Definitions and representation – minimum spanning tree – single-source shortest paths – all-pairs shortest paths.								
UNIT – V	**Parallel Algorithms**					**Hours: 09**		
Search Algorithms for Discrete for Discrete Optimization Problems: Definitions and examples, sequential search algorithms, search overhead factor, parallel depth-first search, parallel best-first search, speedup anomalies in parallel search algorithms. Dynamic Programming: Serial Monadic DP Formulation-Non serial Monadic DP Formulation-Serial Polyadic DP Formulations-Non serial Polyadic DP Formulations Fast Fourier Transform: Serial Algorithm-The Binary Exchange algorithm-The Transpose algorithm								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**			**Total Hours: 60**			
Text Books:								
1. Ananth Grama, Anshul gupta, George Karypis and Vipin Kumar, Introduction to Parallel Computing , Pearson Education, Second edition, 2004. 2. V. Rajaraman and C. Siva Ram Murthy, Parallel Computers – Architecture and Programming , Prentice-								

Hall of India, 2003.

Reference Books:

1. Selim G. Akl, The Design and Analysis of Parallel Algorithms, Prentice-Hall of India, 1999.
2. M.J. Quinn, Parallel Computing – Theory and Practice , McGraw-Hill, 1994.
3. Michael Jay Quinn, Parallel Programming in C with MPI and OpenMP McGraw-Hill, 2003

Websites:

1. http://www.openmp.org
2. http://www.nptel.ac.in
3. http://www/aparallel.com

Department : Computer Science and Engineering		**Programme :** M.Tech. (Distributed Systems)						
Semester : One		**Category :** LB						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CS155	Advance Software Laboratory I	-	-	3	2	60	40	100
Prerequisite	-							
Objectives	• To impart basic working knowledge on distributed system concepts. • To understand the intricacies of distributed architecture environment.							
Outcome	• After doing the lab students are able to understand the distributed systems concepts. • Able to implement time, event relationships and understand the concepts of distributed deadlocks and mutual exclusion. • To gain in depth understanding of distributed architecture environment.							
CYCLE - I	Any experiments from the chosen elective course may be included.							**Hours: 21**
	1. Inter-process communication using socket programming/ RPC mechanism . 2. Threads clock synchronization. 3. Simulation of election algorithms (Ring and Bus Topology) 4. a.Bully b.Ring 5. Distributed/Hierarchical deadlock detection algorithms. 6. Clock synchronization: NTP / Lamports clock.							
CYCLE - II	Any experiments from the chosen elective course may be included.							**Hours: 24**
	1. Load distributing algorithms, Performance comparison. 2. Error recovery in concurrent systems 3. Design and implement client server application using RMI (Remote Method Invocation) 4. Design and implement an application using EJB (Entity Java Beans) session bean business logic and service using stub, i.e., client side proxy object. 5. Design and implement an offline database communication system using JMS (Java Message Service) to service the client request. 6. Develop a simple task manage application that keeps track of tasks execution maintaining which tasks have been executed in eclipse JAVA environment using XML and JAVA servlets/JSP							
Total contact Hours: -	**Total Tutorials: -**	**Total Practical Classes: 45**			**Total Hours: 45**			

Department : Computer Science and Engineering					**Programme :** M.Tech. (Distributed Systems)			
Semester : Two					**Category :** TY			
Subject Code	**Course Name**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CS156	Cloud Computing	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To introduce the basics of Cloud Computing. • To educate the cloud working function. • To Allow computer system resources to be used in an efficient manner. • Makes the environment to the cloud.							
Outcome	On successful completion of the course, students will be able to: • Understand the concepts of cloud computing and its related techniques. • Provide a pleasant and effective user interface							
UNIT – I								**Hours: 09**
Introduction to Cloud Computing- The Evolution of Cloud Computing – Hardware Evolution – Internet Software Evolution – Server Virtualization - Web Services Deliver from the Cloud – Communication-as-a-Service – Infrastructure-as-a-Service – Monitoring-as-aService – Platform-as-a-Service – Software-as-a-Service – Building Cloud Network								
UNIT – II								**Hours:09**
Federation in the Cloud - Presence in the Cloud - Privacy and its Relation to Cloud-Based Information Systems – Security in the Cloud - Common Standards in the Cloud – End-User Access to the Cloud Computing								
UNIT – III								**Hours: 09**
Introduction - Advancing towards a Utility Model – Evolving IT infrastructure – Evolving Software Applications – Continuum of Utilities- Standards and Working Groups - Standards Bodies and Working Groups – Service Oriented Architecture – Business Process Execution Language – Interoperability Standards for Data Center Management - Utility Computing Technology – Virtualization – Hyper Threading – Blade Servers - Automated Provisioning - Policy Based Automation – Application Management – Evaluating Utility Management Technology - Virtual Test and development Environment - Data Center Challenges and Solutions - Automating the Data Center								
UNIT – IV								**Hours: 09**
Software Utility Application Architecture - Characteristics of an SaaS - Software Utility Applications - Cost Versus Value - Software Application Services Framework - Common Enablers – Conceptual view to Reality – Business Profits - Implementing Database Systems for Multitenant Architecture								
UNIT – V								**Hours: 09**
Other Design Considerations - Design of a Web Services Metering Interface - Application Monitoring Implementation - A Design for an Update and Notification Policy - Transforming to Software as a Service - Application Transformation Program - Business Model Scenarios - Virtual Services for Organizations - The Future.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**			**Total Hours: 60**			

Text Books:

1. Guy Bunker and Darren Thomson, Delivering Utility Computing , John Wiley & Sons Ltd, 2012.

Reference Books:

1. John W. Rittinghouse and ames F. Ransome, Cloud Computing Implementation, Management and Security , CRC Press, Taylor & Francis Group, Boca Raton London New York. 2010
2. Alfredo Mendoza, Utility Computing Technologies, Standards, and Strategies Artech House INC, 2007 .

Websites:

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Department : Computer Science and Engineering		**Programme :** M.Tech. (Distributed Systems)						
Semester : Two		**Category :** TCM						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CS157	Service Oriented Architecture and Web Services	3	-	2	4	50	50	100

Prerequisite	-
Objectives	• To gain understanding of the basic principles of service orientation. • To learn advanced concepts such as service discovery , service composition and service oriented analysis techniques. • To practice web service development and deployment in J2EE and .NET environment.
Outcome	On successful completion of the course, students will be able to: • Apply Service Oriented Design principles and techniques for E-Commerce application development. • Experience advanced web service standards and APIs available in J2EE and .NET platform. • Apply recent programming techniques such as Ajax, JSON and JQuery for Web Application Development

UNIT – I	**Hours: 09**
Web services, Evolution and differences with Distributed computing, XML – Namespace, XML-RPC standard, Components of Web Services - WSDL, SOAP, UDD, SOAP vs REST Web Service, Introduction to Web Service Discovery and Composition.	
UNIT – II	**Hours: 09**
Introduction to Service Oriented Architecture, Roots of SOA – Characteristics of SOA - Comparing SOA to client-server and distributed internet architectures – Anatomy of SOA- How components in an SOA interrelate Principles of Service Orientation	
UNIT – III	**Hours: 09**
Platform for Web Services Development, Web services - .NET and J2EE Architecture, J2EE Components & Containers, Java API for XML-based web services (JAX-WS), Java API for XML based RPC (JAX-RPC), ASP.Net Web Service , SOA support in .NET and J2EE, MVC Architecture, Struts.	
UNIT – IV	**Hours: 09**
Web services – Service descriptions – Messaging with SOAP –Message exchange Patterns – Coordination –Atomic Transactions – Business activities – Orchestration (WS-BPEL) – Choreography (WS-CDL) - Service layer abstraction – Application Service Layer – Business Service Layer – Orchestration Service Layer.	
UNIT – V	**Hours: 09**
Web Service Case Study - Web Service Search Engine, Web Service Discovery using UDDI, Web Service Composition using BPEL, Developing an Service oriented E-Commerce application using JSON, J Query and Ajax .	
MINI PROJECT	**Hours: 30**
The students are to be made of batches of two or three members in a team. Each team should select an appropriate project in the realm of cloud computing. At the end of the project each team should prepare a report which consists of at least the following. Abstract, Introduction,Problem Statement, Design Document,Results, Interpretation of the Results.	

Total contact Hours: 45	**Total Tutorials: -**	**Total Practical Classes: 30**	**Total Hours: 75**

Text Books:

1. Thomas Erl, Service-Oriented Architecture: Concepts, Technology, and Design , Pearson Education, 2005.
2. Thomas Erl, SOA Principles of Service Design , The Prentice Hall Service-Oriented Computing Series from Thomas Erl , 2005.
3. Sandeep Chatterjee, James Webber, Developing Enterprise Web Services, An Architect's Guide , Pearson Education, 2005

Reference Books:

1. Dan Woods and Thomas Mattern, Enterprise SOA Designing IT for Business Innovation , O'REILLY, First Edition, 2006

Websites:

Department : Computer Science and Engineering		**Programme :** M.Tech. (Distributed Systems)						
Semester : Two		**Category :** LB						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CS158	Advance Software Laboratory II	-	-	3	2	60	40	100
Prerequisite	-							
Objectives	• To understand the main ideas and concepts on web services. • Working on distributed applications using Integrated development environment . • To understand and get hands on experience in distributed environment.							
Outcome	• To gain knowledge on developing and deploying web services. • To gain knowledge on the flexibility of IDEs . • To realize the importance of reengineering.							
CYCLE - I	Any experiments from the chosen elective courses may be included.							**Hours: 21**
	1. Create a web application using dream weaver/Microsoft Express Editor. 2. Create any web application using MVC Implementation of functional dependencies and closures of functional dependencies. 3. Scientific computing with MapReduce. 4. Distributed job management systems with cloud computing.							
CYCLE - II	Any experiments from the chosen elective courses may be included.							**Hours: 24**
	1. Application design using UML. 2. Implementation of cryptographic algorithms. 3. Generating OWL script using protégé. 4. Simulation of location monitoring system in sensor networks. 5. Attribute relevance analysis in WEKA and Data classification in WEKA.							
Total contact Hours: -	**Total Tutorials: -**	**Total Practical Classes: 45**			**Total Hours: 45**			

Department : Computer Science and Engineering		**Programme :** M.Tech. (Distributed Systems)						
Semester : Two		**Category :** PR						
Subject code	**Subject**	**Hours/week**			**Credit**	**Maximum marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CS159	Research Methodology	-	-	3	1	100	0	100
Prerequisite	-							
Objectives	• To educate students to methods of selection of research problems • To expose students to different research methods							
Outcomes	• Students will be capable to identify and narrow down to the area of research on the basis the requirements of industrial and global requirements • Students will exhibit the domain skill to choose suitable research methods to execute research effectively • Students will possess knowledge to further their academic program, namely, Ph.D. program.							

- **Definition of research:** Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Definition and Dimension of a Theory, Functions and Characteristics; Types of Theory: General Theory and Particular/ Empirical Theory. Cases and their Limitations; Causal Relations. Philosophy and validity of research. Objective of research.
- **Characteristics of research:** Various functions that describe characteristics of research such as systematic, valid, verifiable, empirical and critical approach.
- **Types of research:** Pure and applied research. Descriptive and explanatory research. Qualitative and quantitative approaches.
- **Research procedure:** Formulating the Research Problem, Literature Review, Developing the objectives, Preparing the research design including sample. Design, Sample size.
- **Considerations in selecting research problem:** Relevance, interest, available data, choice of data, Analysis of data, Generalization and interpretation of analysis.
- **Outcome of research:** Significance of report writing – Layouts of the research report – Types of reports – Oral presentation – Mechanics of writing research report – Precautions for writing research reports – Plagiarism and copy right violation – Patent writing and filing.

Total contact hours: -	**Total tutorials: -**	**Total practical classes:15**	**Total hours: 15**

Reference books:

1. Dawson, Catherine, Practical Research Methods, UBS Publishers and Distributors, New Delhi, 2002
2. Kothari, C.R., Research Methodology-Methods and Techniques, Wiley Eastern Limited, New Delhi, 1985.
3. Kumar, Ranjit, Research Methodology, A Step-by-Step Guide for Beginners, (2nd.ed), Pearson Education, Singapore, 2005.

Department : Computer Science and Engineering		**Programme :** M.Tech. (Distributed Systems)						
Semester : Three		**Category :** PR						
Subject Code	**Course Name**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CS160	Project Work (Phase I)	-	-	-	9	150	150	300
Prerequisite	-							
Objectives	• To expose students with project-product development cycle using of state-of-art technologies. • To understand the Product Development Cycle through Project. • To plan for various activities of the project.							
Outcome	• Exposure to Learning and knowledge access techniques using Conferences, Journal papers and participation in research activities.							
Phase I								
	1. Select a Research Problem. 2. Conduct a Survey in the chosen area. 3. Perform a feasibility study. 4. Study the limitations of the Existing System. 5. Define the Problem Statement and Objectives. 6. Choose the Research Methodology. 7. Finalize the Experimental Environment. 8. Choose the evaluation parameters. 9. Implement the Existing System. 10. Document the outcome of Phase I.							
Total contact Hours: -	**Total Tutorials: -**	**Total Practical Classes: -**				**Total Hours: -**		

Department : Computer Science and Engineering				**Programme :** M.Tech. (Distributed Systems)						
Semester : Four				**Category :** PR						
Subject Code	**Course Name**	**Hours / Week**			**Credit**	**Maximum Marks**				
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**		
CS161	Project Work (Phase II)	-	-	-	14	200	200	400		
Prerequisite	-									
Objectives	• To encourage and expose students for participation in National/ International paper presentation activities. • Acquire in depth working knowledge in the chosen area of problem.									
Outcome:	• Acquire knowledge and skills needed for the construction of highly software project . • Enhance the technical presentation skills. • Inculcate the practice of publishing in Conferences and Journal .									
Phase I										
	1. High level Design of the Proposed Solution. 2. Detailed Design of the Proposed Solution. 3. Implementation of the Proposed Solution. 4. Comparison of the performance with the existing system. 5. Document the results in the Project Report.									
Total contact Hours: -	**Total Tutorials: -**	**Total Practical Classes: -**			**Total Hours: -**					

SYLLABUS (Elective Subjects)

Department : Computer Science and Engineering		**Programme :** M.Tech. (Distributed Systems)						
Semester :		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CSE51	Mobile Computing Systems	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• Introduction to the basics of Wireless transmission basics. • To have a wide knowledge on Layers in Mobile Layers. • Security issues in Mobile Computing.							
Outcome	On successful completion of the course, students will be able to: • Posses knowledge on digital data transfer and digital mobile communication systems. • Knowledgeable Protocols in mobile network layer and transport layer. • Be well versed in the standards and issues in Wireless and Mobile Computing.							
UNIT – I	**Mobile Computing**							**Hours: 09**
Introduction – Technology overview – Research Issues –Dialogue control – Middleware and Gateway- Application and services – Security – Standards- Architecture of Mobile Software Applications – Signals – Antennas and its types- Signal propagation – MAC								
UNIT – II	**Telecommunication**							**Hours: 09**
Group of Special mobile – General Packet Radio Service – Digital Enhanced Cordless telecommunication (DECT) – IMT-2000 and UMTS- Satellite communication basics – Satellite network configuration – Allocation of Frequency for mobile satellite services – Iridium Systems – Digital Video broadcasting – Wireless Application Protocol (WAP)								
UNIT – III	**Mobile Network Layer**							**Hours: 09**
Mobile IP- IP Packet Delivery- Agent Advertisement and Discovery – Registration-Tunneling and Encapsulation-Optimizations- Reverse Tunneling - IPv6-Dynamic Host Configuration Protocol. Ad Hoc Networks: Routing-Destination Sequence Distance Vector-Dynamic Source Routing-Hierarchical Algorithms. Mobile Transport Layer: Traditional TCP-Congestion Control -Indirect TCP- Snooping TCP-Mobile TCP								
UNIT – IV	**Mobility and Location Based Services**							**Hours: 09**
Data Acquisition of Location Information – GIS - Location Information Modeling - Location-Based Services Applied - Utilizing Location-Based Services with Mobile Applications - Representing Location with UML - Security and Privacy of Location Information - Localization and Internationalization - Latest Developments in Location-Based Efforts								
UNIT – V	**Security Issues in Mobile Computing**							**Hours: 09**
Information Security – Techniques and Algorithm – Security Protocols – Public Key Infrastructure – Trust – Security Models – Security Framework for mobile computing.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**			**Total Hours: 60**			

Text Books:

1. Asoke K. Talukar, Mobile Computing, Second Edition, Tata McGraw-Hill publication, 2010.
2. Reza B'Far ,Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML ,Cambridge University Press, 2004.

Reference Books:

1. Tomasz Imielinski and Henry F. Korth ,Mobile Computing,Springer Science & Business Media, 1996
2. V. Jeyasri Arokiamary ,Mobile Computing, Technical publication, 3rd edition, 2009.

Websites:

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Department : Computer Science and Engineering		**Programme :** M.Tech. (Distributed Systems)						
Semester :		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CSE52	Information Retrieval Techniques	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• Apply machine learning techniques to text classification and clustering which is used for efficient • Identify and design the various components of an Information Retrieval system Information Retrieval • Design cross language information retrieval systems.							
Outcome	On successful completion of the course, students will be able to: • Build an Information Retrieval system using the available tools • Ability to analyze the Web content structure • Design an efficient search engine							

UNIT – I	**Introduction**	**Hours: 09**

Basic Concepts–Practical Issues-Retrieval Process–Architecture-Boolean Retrieval–Retrieval Evaluation–Open Source IR Systems–History of Web Search–Web Characteristics–The impact of the web on IR—IR versus Web Search–Components of a Search engine-Searching the Web –Structure of the Web–IR and web search–Static and Dynamic Ranking-Web Crawling and Indexing–Link Analysis.

UNIT – II	**Ontology**	**Hours: 09**

Ontology Development-taxonomies-Topic maps-Ontology-Definition-expressing ontology logically-ontology representations-XML-RDF-RDFS-OWL-OIL-ontology development for specific domain-ontology engineering-Semantic web services.

UNIT – III	**Modeling and Indexing**	**Hours: 09**

Taxonomy and Characterization of IR Models–Boolean Model–Vector Model-Term Weighting–
Scoring and Ranking–Language Models–Set Theoretic Models-Probabilistic Models–Algebraic Models–Structured Text Retrieval Models–Models for Browsing. Indexing -Static and Dynamic Inverted Indices–Index Construction and Index Compression. Searching-Sequential Searching and Pattern Matching. Query Operations-Query Languages–Query Processing-Relevance Feedback and Query Expansion-Automatic Local and Global Analysis.

UNIT – IV	**Evaluation and Text Classification**	**Hours: 09**

Measuring Effectiveness and Efficiency Multimedia IR: Models and Languages–Indexing and Searching Parallel and Distributed IR–Digital Libraries**. Text Classification -**Vector Space Classification–Support vector machines and Machine learning on documents. Flat Clustering –Hierarchical Clustering–Matrix decompositions and latent semantic indexing.

UNIT – V	**CLIR and Latest Trends**	**Hours: 09**

Cross language information retrieval - CLIR- Translation systems - Translation Based on Parallel and Comparable Corpora - Methods to improve CLIR- Latest Trends in IR- Query by Example - Query Expansion - Automatic summarization- Concept-based Searching.

Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**	**Total Hours: 60**

Text Books:

1. Ricard o Baeza Yates, BerthierRibeiro –Neto, Modern Information Retrieval: The concepts and Technology behind Search (ACM Press Books), Second Edition ,2011
2. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, Introduction to Information Retrieval, Cambridge University Press, First South Asian Edition, 2012
3. Michael c.Daconta,leo J. Obart and Kevin J Smith, Semantic Web – A guide to the future of XML, Web Services and Knowledge management ,Wiley Publishers ,2003
4. Jian-Yun Nie and Graeme Hirst, cross – Language Information Retrieval, (Synthesis Lectures on Human Language Technologies) , Morgan & Claypool Publishers, 2009.

Reference Books:

1. Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, Information Retrieval Implementing and Evaluating Search Engines, The MIT Press, Cambridge, Massachusetts London, England, 2010
2. Ricardo Baeza–Yates, Berthier Ribeiro–Neto, Modern Information Retrieval, Pearson Education, Second Edition,2005

WebSites:

1. http://nptel.ac.in/courses/106101007/

Department : Computer Science and Engineering		**Programme :** M.Tech. (Distributed Systems)						
Semester :		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CSE53	Advanced Distributed System Architectures	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To learn the state of the art in distributed system architectures. • To understand the advantages and disadvantages of various distributed system architectures. • To understand the management of distributed System architectures in industrial organizations.							
Outcome	On successful completion of the course students will be able to: • Adopt appropriate architecture for real-world distributed system. • Develop and implement new ideas to solve open problems in distributed systems. • Design Enterprise Applications with the use of Service Oriented Architecture.							

UNIT – I	**Introduction**	**Hours: 09**

Introduction Distributed Systems: Characteristics of Distributed Systems – Types of Distributed System – Challenges in Designing Distributed Systems – **Architecture:** Architectural Styles – System Architectures – Centralized Architectures – Decentralized Architectures – Hybrid Architectures – Architectures Versus Middleware – Interceptors – General Approaches to Adaptive Software – Self-Management in Distributed Systems – The Feedback Control Model – Architectural Patterns for Distributed System Architectures.

UNIT – II	**Middleware**	**Hours: 09**

Base Middleware: NOS Middleware – Transparency - Global Directory Services - Distributed Time Service - Distributed Security Service – Peer to Peer Communication – RPC – Messaging and Queuing (MOM)- MOM Vs RPC – NOS and NOS trends – **SQL Database Servers:** SQL Database Servers – SQL Middleware and Federated Databases – **Data Warehouses:** Information source – **EIS/DSS:** From Queries, To OLAP, to Data Mining – Commercial and open source solutions.

UNIT – III	**Client-Server Architecture**	**Hours: 09**

Multiprocessor architectures – **Client-server architectures:** Introduction to Client/Server Computing – Client/Server Building Blocks – Client -Server model – Two-tier Client -Server – Three-tier Client -Server – Three-tier or multi-tier – Thin Client – Fat Client – **Client/Server Transaction Processing :** The basics of Transactions – **TP Monitors:** Managing Client/Server Transactions – TP-Lite or TP-Heavy – TP Monitors –**Client/Server Groupware**: Component of Groupware – Client/Server Distributed System Management– Distributed System Management Standards – Client/Server Tools and Application Development.

UNIT – IV	**Distributed Object Architecture**	**Hours: 09**

Client/Server With Distributed Objects: – Distributed Objects and Components- Advantages of distributed object architecture – Uses – CORBA – CORBA application structure – CORBA standards – CORBA objects – Object request broker – ORB-based object communications – Inter-ORB communications – CORBA services – ORBs To Enterprise Beans – COM+: The Other Component Bus – Object Databases – Distributed Objects – **Client/Server and the Internet:** The Hypertext Era – The Interactive Era – The Distributed Object Era.

UNIT – V	**Inter-Organizational Distributed Architecture**	**Hours: 09**

Peer-Peer Architecture: Peer-to-Peer paradigm – features and challenges – Placing Information Security within an Organization – Differentiate Peer-to-Peer with client server paradigms – Centralized P2P Systems: SETI (Search for Extraterrestrial Intelligence), Napster – Advantages and Disadvantages – Decentralized P2P Systems: Unstructured P2P systems and Structured P2P systems – Gnutella, FreeNet, Avaki and PAST– Hybrid P2P Systems: BestPeer – DHT-based P2P systems – **Service Oriented Architecture:** Fundamental SOA – Characteristics–Workflow of SOA– Tangible benefits – Pitfalls – Evolution of SOA – Comparing SOA to past architectures – REST and systems of systems – Web services and SOA – Service Oriented Architecture for Enterprise Applications – Other SOA and systems.

Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**	**Total Hours: 60**

Text Books:

1. Robert Orfali, Dan Harkey and Jeri Edwards, Client/server Survival Guide, 3rd Edition, Wiley India Pvt Ltd, 2007.
2. Thomas Erl, Service-Oriented Architecture: Concepts, Technology & Design, Pearson Education Pvt Ltd, 2008.

3. Andrew S.Tanenbaum and Maarten Van Steen, Distributed Systems, Pearson Education, 2014.

Reference Books:

1. Abhijit Belapurkar, Anirban Chakrabarti, Harigopal Ponnapalli, Niranjan Varadarajan, Srinivas Padmanabhuni and Srikanth Sundarrajan, Distributed Systems Security: Issues, Processes and Solutions, Wiley Pubilications, 2009.
2. Gupta,IT Infrastructure and Its Management, Tata Mc graw Hill Publishing Company Limited 2009.
3. Q.H. Vu, Lupu,M and Oai,B.C., Peer-to-Peer Computing, Springer-Verlag Berlin Heidelberg, 2010.
4. Kai Hwang, Jack Dongarra and Geoffrey C. Fox, Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, Morgan Kaufmann Publishers, 2011.

Websites:

1. https://msdn.microsoft.com/en-us/library/dd129906.aspx
2. www.aosabook.org/en/distsys.html
3. jan.newmarch.name/go/arch/chapter-arch.html
4. http://www.vitanuova.com/inferno/papers/styx.html

Department : Computer Science and Engineering		**Programme :** M.Tech. (Distributed Systems)						
Semester :		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CSE54	Machine Learning	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	The students are to • Be exposed to the overview of machine learning and supervised learning. • Understand the decision theory and parametric methods. • Understand the underlying mathematical and probability structures in Machine learning. • Get an overview of the dimensionality reduction and Clustering.							
Outcome	At the end of the course the students will be able to: • Understand the theories and concepts of supervised learning. • Identify, formulate and analyze machine learning problems. • Interpret the process and evaluation model to get the results.							
UNIT – I	**Introduction and Supervised Leaning**							**Hours: 09**
Introduction to Machine Learning – Applications – Learning Associations – Classification – Regression – Unsupervised Learning – Reinforcement Learning – Supervised Learning – Vapnik-Chervonenkis (VC) Dimension – Probably Approximately Correct (PAC) Learning – Noise – Learning multiple classes – Model selection and Generalization.								
UNIT – II	**Bayesian Decision Theory** and **Parametric Methods**							**Hours: 09**
Bayesian Decision Theory – Classification – Losses and Risks – Discriminant Functions – Utility theory – Value of Information – Bayesian Networks – Influence Diagrams – Association rules – Parametric methods – Maximum Likelyhood estimation – Bernoulli Density – Multinomial Density – Gaussian Density – Bias and Variance – Bayes' estimator –Tuning Model complexity – Model selection procedures.								
UNIT – III	**Multivariate Methods and Dimensionality Reduction**							**Hours: 09**
Multivariate methods – Parameter estimation – Multivariate Normal Distribution – Tuning Complexity – Discrete Features – Multivariate regression – Dimensionality reduction – Subset selection – Principal component analysis – Factor analysis – Multidimensional scaling – Linear discriminate analysis.								
UNIT – IV	**Clustering and Non-Parametric Methods**							**Hours: 09**
Clustering – Mixture densities – k-Means clustering – Expectation-Maximization algorithm –Hierarchical clustering – Non-parametric methods – Histogram estimator – Kernel estimator – k-Nearest neighbor estimator – Decision trees – Univariate trees – Pruning – Rule extraction from trees – Learning rules from data – Multivariate trees.								
UNIT – V	**Multilayer Perceptions and Local Models**							**Hours: 09**
Multilayer perceptions – Neural networks – perceptron – Training a perceptron – Back propagation algorithm – Local models – Competitive learning – Radial basis functions – Mixture of experts – Hidden Markov models – Discrete Markov processes – Evaluation problem – State sequence – Learning model parameters – Model selection in HMM.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**			**Total Hours: 60**			

Text Books:

1. Ethem Alpaydin, Introduction to Machine Learning , MIT Press, 2004.

Reference Books:

1. Jaime Guillermo Carbonell and Tom Michael Mitchell, Machine Learning , Morgan
2. Kaufmann, 1994.
3. Goldberg and David E, Genetic Algorithms in Search. Optimization and Machine
4. Learning , Pearson Education, New Delhi, 1989.

Websites:

1. www.cmpe.boun.edu.tr/~ethem/i2ml2e
2. http://dl.acm.org/citation.cfm?id=1734076

Department : Computer Science and Engineering		**Programme :** M.Tech. (Distributed Systems)						
Semester :		**Category :** TY						
Subject Code	**Course Name**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CSE55	Agent Technology	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	The students are to • Be introduced the concepts, techniques and applications of software agents. • Get an overview of problem solving technique using agent technology • Acquire an understanding of agent based system development							
Outcome	At the end of the course the students will be able to: • Understand the basic concepts techniques and applications of software agents. • Learn to develop a agent based system. • Gain Knowledge in Multi agent and Intelligent agents.							
UNIT – I								**Hours: 09**
Introduction to Agents (Definition, Properties, Lifecycle, Environment, Types, Uses, Applications, Programming paradigm, Communications, Architecture) – Multi-Agent Systems (MAS) **–** Interaction between agents – Reactive Agents – Cognitive Agents – Interaction protocols – Agent coordination – Agent negotiation – Agent Cooperation – Agent Organization – Self-Interested agents in Electronic Commerce Applications.								
UNIT – II								**Hours: 09**
Distributed Problem Solving and Planning – Introduction – Task Sharing – Result Sharing – Distributed Planning – Distributed Planning and Execution. Search Algorithm for Agents – Constraint satisfaction – Path finding problem – two player game								
UNIT – III								**Hours: 09**
Distributed Relation Decision making – Introduction Evaluation Criteria – Voting – Auctions – Bargaining – General Equilibrium market mechanisms – Contract nets – coalition formation Learning in multi-agent system – Learning and activity coordination – Learning about and from other agents – Learning and Communication.								
UNIT – IV								**Hours: 09**
Computational Organization Theory – Introduction Organizational Concepts useful in modeling organizations Formal Methods in DAI – Logic based representation and reasoning.								
UNIT – V								**Hours: 09**
Agent based system development Lifecycle (Agent oriented analysis, Agent oriented design, Agent oriented Implementation) – Agents Development frameworks and languages – JADE, AGLET – Agent Communication Languages – KQML – Agent Oriented methodologies – GAIA, MASE, Tropos, Prometheus.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**			**Total Hours: 60**			
Text Books:								
1. Bradshaw, Software Agents , MIT Press, 2000 2. Michael Wooldridge, Introduction to Multi-agent system , John Wiley & Sons, 2002,								
Reference Books:								
1. Gerhard Weiss, Multi-agent system – A modern approach to Distributed Artificial Intelligent, MIT press, 2000. 2. Walter Brenner et al,, Intelligent Software agents: Foundations and Applications Springer Verlag. 1998								
Websites: -								

Department : Computer Science and Engineering		**Programme :** M.Tech. (Distributed Systems)						
Semester :		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CSE56	Optical Communication Networks	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• Illustrate the concepts of static traffic routing and the constraints related to virtual topology design and identify the importance of Optical communication. • Explain the mechanism to transfer the control information in optical networks. • Design an algorithm for dynamically establishing a lightpath. • Design an optical network which works under IP network.							
Outcome	On successful completion of the course, students will be able to: • Appriciate the necessity of static traffic routing and constraints involved in it. • Distiguish between static traffic routing and dynamic traffic routing. • Explain the concepts related to virtual topology reconfiguration, survivability of the network. • Develop algorithms to transfer traffic in an IP-over-WDM network environment.							
UNIT – I	**Types of Optical Networks**							**Hours: 09**
Introduction to optical networks – Principles of optical transmission – Evolution of optical networks – Components and enabling technologies – Wavelength division multiplexing (WDM) – WDM network architectures, broadcast-and-select networks, linear lightwave networks, and wavelength routed networks – Issues in broadcast-and-select networks.								
UNIT – II	**Static Routing and Virtual Topology Design**							**Hours: 09**
Static traffic routing in wavelength routed networks – Virtual topology design – problem formulation and algorithms - design of multi-fiber networks – Virtual topology reconfiguration – problem formulation - reconfiguration due to traffic changes - reconfiguration for fault restoration – Network provisioning.								
UNIT – III	**Dynamic Routing**							**Hours: 09**
Dynamic traffic routing in wavelength routed networks – Routing and wavelength assignment algorithms – Centralized and distributed control – Introduction to Wavelength convertible networks – Wavelength rerouting.								
UNIT – IV	**Control Management of Optical Network**							**Hours: 09**
Control and Management – Functions – Framework – Information Model – Protocols – Optical layer Services and Interfacing – Network Survivability – Protection in SONET / SDH – Protection in IP Networks – Optical Layer Protection – Schemes.								
UNIT – V	**Advanced Issues**							**Hours: 09**
Next generation optical Internets – burst switching – packet switching (IP-over-WDM) – Multicast traffic routing – source rooted trees - Access Networks – PON, FTTC, FTTH – Traffic Grooming – Optical Burst Switching.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**			**Total Hours: 60**			

Text Books:

1. C. Siva Ram Murthy and Mohan Gurusamy, WDM Optical Networks: Concepts, Design, and Algorithms, Prentice-Hall of India, 2002.
2. B. Mukherjee,Optical WDM Networks, Springer, 2006.
3. Rajiv Ramaswami and Kumar N. Sivarajan, Optical Networks: A Practical Perspective, Morgan Kaufmann (Elsevier Indian Edition), Second edition, 2004.

Reference Books:

1. Greg Bemstein, Bala Rajagopalan and Debanjan Saha,Optical Network Control – Architecture, Protocols and Standards, Pearson Education, 2004.
2. Uless Black, Optical Networks - Third Generation Transport Systems, Pearson Education, 2002.

Web Sites :

1. http://www.cse.wustl.edu/~jain/cis788-99/ftp/dwdm.pdf
2. http://www.cse.buffalo.edu/~qiao/cse620/wdm_reconfig.ppt
3. http://grail.cba.csuohio.edu/~arndt/optical%20network.ppt
4. http://sit.iitkgp.ernet.in/research/aut05vol/topic4.ppt
5. http://www.cambridge.org/resources/0521868009/5963_OSN_chapter9.ppt

Department : Computer Science and Engineering		**Programme :** M.Tech. (Distributed Systems)						
Semester :		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CSE57	Software Architecture	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To learn how to develop quality software products • To introduce fundamentals of software design • To understand the software architecture evaluation process							
Outcome	• Students would have acquired traits of a good software architect • Students would be able to design software products that ensures quality • Students would be able to choose from a set of alternative designs							
UNIT – I	**Concepts of Design**							**Hours: 09**
Characteristics of design activities – Elements of design – Software quality models and their effects – Quality Attributes – Basic rules of software design – Design process.								
UNIT – II	**Software Architecture**							**Hours: 09**
Architecture – Software Architecture – Architectural styles – Visual Notation- Active and passive elements – Data, control and relationships – composition and decompositions – Data Flow Style – Call and Return – Independent components – Data centered and virtual machine.								
UNIT – III	**Styles in Design and Design Space**							**Hours: 09**
Choices of styles and their combination – Hierarchical styles – Simultaneously heterogeneous style – Locationally heterogeneous style – Theory of design spaces – Design Space of elements – Design Space of Styles.								
UNIT – IV	**Architecture Evaluation**							**Hours: 09**
Concept of Scenario – Evaluating modifiability – Evaluating Performance – SAAM Method – The process: Analysis and Evaluation of modifiability.								
UNIT – V	**Architecture Evaluation Methods**							**Hours: 09**
ATAM – Analysis Process – Analysis Activities – Quality Models – Construction of quality models – Derivation of quality features.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**			**Total Hours: 60**			

Text Books:

1. Hong Zhu, Software Design Methodology: From Principles to Architectural Styles , Butterworth-Heinemann Elsevier Publishers, 2013.

Reference Books:

1. Ian Gorton, Essential Software Architecture , Springer – Verlag, Berlin Heidelberg, 2008.
2. Paul Clements, Rick Kazman and Mark Klein, Evaluating Software Architectures – Methods and Case Studies , Pearson Low Price Edition, India, 2008.
3. Mary Shaw and David Garlan, Software Architecture – Perspectives of an Emerging Discipline , Prentice-Hall of India, 2008.
4. Mahesh P. Matha, Object Oriented Analysis and Design using UML , Prentice-Hall of India, 2008.
5. Bernd Bruegge, Allen H. Dutoit, Object-Oriented Software Engineering Using UML, Patterns, and Java , Pearson Low Price Edition, India, 2008.

Websites:

1. http://www.bredemeyer.com/
2. http://www.ibm.com/developerworks/rational/library/feb06/eeles/
3. http://www.sei.cmu.edu/architecture/

Department : Computer Science and Engineering		**Programme :** M.Tech. (Distributed Systems)						
Semester :		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CSE58	Distributed Algorithms	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To gain depth knowledge about the Distributed Algorithms • To design efficient algorithms using Distributed Algorithmic Techniques • Introduce development of distributed algorithms for solving larger engineering problems							
Outcome	On successful completion of the course, students will be able to: • Design and Develop the algorithms using Distributed programming principle • Identify, analyze, formulate and solve larger engineering problems. • Analyze and Implement different algorithm design techniques							
UNIT – I	**Distributed Algorithms**							**Hours: 09**
Introduction to Distributed Algorithms-Kinds of Distributed Algorithm- Timing Models. Synchronous Network Algorithms: Synchronous Network Model-Leader Election in a synchronous Ring- Algorithms in a General Synchronous Networks- Distributed Consensus with Link Failures- Distributed Consensus with Process failures- More Consensus problems								
UNIT – II	**Asynchronous Algorithms**							**Hours: 09**
Introduction - Asynchronous System Model. Asynchronous Shared Memory Algorithms: Asynchronous Shared Memory Model-Mutual Exclusion-Resource Allocation-Consensus-Atomic Objects.								
UNIT – III	**Asynchronous Network Algorithms**							**Hours: 09**
Introduction - Asynchronous Network Model- Basic Asynchronous Network Algorithms-Synchronizers-Shared Memory versus Networks- Logical Time, Global Snapshots and Stable properties.								
UNIT – IV	**Network Resource Allocation**							**Hours: 09**
Introduction – Mutual Exclusion-General Resource Allocation- Asynchronous Networks with Process Failures: The Network Model-Impossibility of Agreement in the presence of Faults- A Randomized Algorithm- Failure Detectors- k-Agreement- Approximate Agreement. Data Link Protocols: The Problem- Stenning's Protocol- alternating Bit Protocol- Bounded Tag protocols tolerating Reordering-Tolerating Crashes.								
UNIT – V	**Partially Synchronous Algorithms**							**Hours: 09**
Introduction – Partially Synchronous System Models: MMT and General Timed Automata- Properties and Proof methods-Modeling Shared Memory and Network Systems. Mutual Exclusion with Partial Synchrony: A single-register algorithm- Resilience to Timing Failures- Impossibility Results. Consensus with partial Synchrony: A Failure Detector, Basic Results-An Efficient algorithm.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**			**Total Hours: 60**			
Text Books:								
1. Nancy A. Lynch, "Distributed Algorithms", Morgan Kaufmann Publishers, 2000.								
Reference Books:								
1. Geral Tel, Introduction to Distributed algorithms , 2nd Edition, Cambridge, 2004. 2. Nicola Santoro, Design and Analysis of Distributed Algorithms , Wiley-Interscience, John Wiley & Sons, Inc., Publication, 2007.								
Websites :								
1. http://nptel.ac.in								

Department : Computer Science and Engineering		**Programme :** M.Tech. (Distributed Systems)						
Semester :		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CSE59	Data Mining and Warehousing Techniques	3	1	-	4	40	60	100

Prerequisite	-
Objectives	• To familiarize with clustering, classification and association rule mining algorithms. • To develop and apply critical thinking, problem-solving, and decision-making skills. • To understand the overall architecture of a data warehouse techniques and Hardware and operational design methods.
Outcomes	On successful completion of the course, students will be able to: • Discover interesting patterns from large amount data to analyze and extract patterns to solve problems, make predictions of outcomes • Select and apply proper data mining algorithm to build analytical applications • Explore Data warehousing methods and device efficient and cost effective methods for maintaining Data warehousing

UNIT – I	**Data Mining**	**Hours: 09**

Data Mining: - Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation. Association Rule Mining: - Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining

UNIT – II	**Classification and Prediction**	**Hours: 09**

Classification and Prediction: - Issues Regarding Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section.

UNIT – III	**Cluster Analysis**	**Hours: 09**

Cluster Analysis: - Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High- Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis.

UNIT – IV	**Data Warehousing and Business Analysis**	**Hours: 09**

Data warehousing Components –Building a Data warehouse – Mapping the Data Warehouse to a Multiprocessor Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools – Metadata – reporting – Query tools and Applications – Online Analytical Processing (OLAP) – OLAP and Multidimensional Data Analysis.

UNIT – V	**Trends in Mining**	**Hours: 09**

Mining of Complex Data Objects, Spatial Databases, Multimedia Databases, Time Series and Sequence Data, Text Databases, World Wide Web, Applications and Trends in Data Mining. **Case Studies:** Data Mining Techniques for Optimizing Inventories for Electronic Commerce, Crime Data Mining, Retailing Bank Customer Attrition Analysis.

Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**	**Total Hours: 60**

Text Books:

1. Jiawei Han and Micheline Kamber , Data Mining Concepts and Techniques, Second Edition, Elsevier, Reprinted 2008.
2. Alex Berson and Stephen J. Smith,Data Warehousing, Data Mining & OLAP , Tata McGraw – Hill Edition, Tenth Reprint 2007.
3. G. K. Gupta ,Introduction to Data Mining with Case Studies , Easter Economy Edition, Prentice Hall of India, 2006.
4. K.P. Soman, Shyam Diwakar and V. Ajay ,Insight into Data mining Theory and Practice , Easter Economy Edition, Prentice Hall of India, 2006.

Reference Books:

1. 1.Margaret H. Dunham, Data Mining: Introductory and Advanced Topics , Pearson Education, 2004.
2. 2. Alex Berson and Stephen J. Smith, Data Warehousing, Data mining and OLAP , Tata McGraw-Hill, 2004
3. 3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar ,Introduction to Data Mining, Pearson Education,

2007

4. 4. Sam Anahory and Dennis Murray, Data Warehousing in the real world, Addison Wesley 2003.
5. 5. Bing Liu. Sentiment Analysis and Opinion Mining, Morgan & Claypool Publishers, May 2012.

Websites:

1. http://web.engr.illinois.edu/~hanj/bk2/datamining concepts
2. http://www.cs.waikato.ac.nz/ml/weka/data mining software in java
3. http://datawarehouse4u.info/
4. http://data-warehouses.net/architecture/
5. http://www.cis.syr.edu/~hhuang13/cis600/notes.html

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Semester :		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CSE60	Multi core Programming	3	1	-	4	40	60	100
Prerequisite	• Parallel Computing							
Objectives	• Understand the challenges in parallel and multi-threaded programming. • Learn about the various parallel programming paradigms, and solutions.							
Outcome	On successful completion of the course, students will be able to: • Develop Program for Parallel Processors. • Develop programs using OpenMP and MPI. • Compare and contrast programming for serial processors and programming for parallel processors							
UNIT – I	**Introduction to Parallel Computing**							**Hours: 09**
Single core to Multi-core architectures – SIMD and MIMD systems – Interconnection networks - Symmetric and Distributed Shared Memory Architectures – Cache coherence – Performance Issues – Parallel program design. Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes								
UNIT – II	**Shared-Memory Programming with Pthreads**							**Hours: 09**
Processes, Threads, and Pthreads – Execution of threads - Matrix-Vector Multiplication- Critical Sections-Busy waiting – mutexes - Producer-Consumer Synchronization and Semaphores- Barriers and Condition Variables- Read-Write Locks- Caches, Cache Coherence, and False Sharing- Thread-Safety								
UNIT – III	**Shared Memory Programming with OpenMP**							**Hours: 09**
OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs – Library functions – Handling Data and Functional Parallelism – Handling Loops – Performance Considerations								
UNIT – IV	**Distributed Memory Programming with MPI**							**Hours: 09**
MPI program execution – MPI constructs – libraries – MPI send and receive – Point-to-point and Collective communication – MPI derived datatypes – Performance evaluation.								
UNIT – V	**Parallel Program Development**							**Hours: 09**
Case studies – n-Body solvers – Tree Search – OpenMP and MPI implementations and comparison.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes:-**			**Total Hours: 60**			

Text Books:

1. 1. Peter S. Pacheco, An Introduction to Parallel Programming, Morgan-Kauffman/Elsevier, 2011.
2. Darryl Gove, Multicore Application Programming for Windows, Linux, and Oracle Solaris, Pearson, 2011

Reference Books:

1. Michael J Quinn, Parallel programming in C with MPI and OpenMP , Tata McGraw Hill, 2003
2. Shameem Akhter and Jason Roberts, Multi-core Programming , Intel Press, 2006.

Websites:

1. http://www.openmp.org
2. http://www.nptel.ac.in
3. https://gcc.gnu.org
4. http://www.open-mpi/

Department : Computer Science and Engineering		**Programme :** M.Tech. (Distributed Systems)						
Semester :		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CSE61	Ad hoc and Sensor Networks	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To study the applications of ad hoc networks • To understand the specific challenges in protocol design • To design energy efficient and QoS aware protocols • To familiarize about the taxonomy of MANETs and WSNs							
Outcome	On successful completion of the course, students will be able to: • Design their own protocol at any stack • Evaluate the performance through experiments and simulations • Design energy-efficient protocols and applications							
UNIT – I								**Hours: 09**
Introduction to Mobile Ad hoc Networks (MANETs) – Characteristics – Challenges – Wireless LANs – Medium Access Layer issues – Hidden and Exposed Terminal Problems – Collision Avoidance – IEEE 802.11 DCF – MAC level security – Power management – QoS provisioning.								
UNIT – II								**Hours: 09**
Routing in Ad hoc Networks: Topology and Position based approaches – proactive and reactive protocols – Hybrid approach – Signal Stability Routing – Power Aware Routing – Associativity based routing – QoS aware Routing – Multicast routing - Geocasting – TCP over MANETs – Mobile IP – Encapsulation – Tunnelling.								
UNIT – III								**Hours: 09**
Wireless Mesh Networks – Architecture – Channel Assignment – Directional Antenna Systems – Protocol issues – Multi-channel MAC – WPANs – Bluetooth – Piconet – Scatternet – Security – Enhancements – IEEE 802.15.3 and IEEE 802.15.4. protocol descriptions.								
UNIT – IV								**Hours: 09**
Introduction to Wireless Sensor Networks: Applications – Radio Characteristics – Energy constraints - MANETs versus WSNs – Sensor node architecture – Berkeley Motes – Localisation - Taxonomy – Operating environment – Data Aggregation – Clustering – MAC protocols for WSNs – S-MAC – T-MAC – IEEE 802.15.4 – Zigbee protocol – Operating Systems – Design Issues – TinyOS – TOSSIM - Multichannel WSNs – Case Study: Development of Home Automation System.								
UNIT – V								**Hours: 09**
Routing protocols for WSNs – Directed Diffusion – PEGASIS – LEACH – Geographical Routing – Transport Protocol – Design issues – CODA – ESRT – RMST – GARUDA – PSFQ – ATP – Transport protocol performance – WSN middleware – Middleware Linking MiLAN – Middleware Service for Monitoring (MSM) – Cluster based light weight Middleware Framework (CLMF) – WSN security – Actuators – Controlled environment.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**			**Total Hours: 60**			

Text Books:

1. Carlos de Morais Cordeiro, Dharma Prakash Agrawal, Ad Hoc and Sensor Networks: Theory and Applications , 2nd Edition, Cambridge University Press, 2011
2. Kazem Sohraby, Daniel Minoli, Taieb, Znati, Wireless Sensor Networks: Technology, Protocols and Applications , 1st Edition, John-Wiley & Sons, 2007.

Reference Books:

1. C. Siva Ram Murthy, B. S. Manoj, Ad Hoc Wireless Networks: Architectures and Protocols , 1st Edition, Pearson Education, 2004.
2. Srikanta Patnaik, Xiaolong Li, Yeon-Mo Yang, Recent Development in Wireless Sensor and Ad Hoc Networks , 1st Edition, Springer-India, 2015

Websites:

1. Autonomous Networks Research Group, University of Southern California, available at https://anrg.usc.edu
2. Research publications by Prof. Ian Akyildiz, Georgia Institute of Technology, available at http://www.ece.gatech.edu/research/labs/bwn/publications.html
3. Multimedia Wireless Networks (MWN) Group, IIT Kanpur, available at http://www.iitk.ac.in/mwn/

Department : Computer Science and Engineering		**Programme :** M.Tech. (Distributed Systems)						
Semester :		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CSE62	Network Management Systems	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• Understand general concepts and architecture behind standards based network management. • Understand concepts and terminology associated with SNMP and TMN. • Get a feeling of current trends in network management technologies. • Understand Technologies used for network management.							
Outcome	On successful completion of the course, students will be able to: • Develop a clear understanding of network management. • Understand clearly SNMP versions 1 and 2, with TMN. • Understand the tools and able to manage the network using web based NMS.							

UNIT – I	**Data Communications and Network Management Overview**	**Hours: 09**
Analogy of Telephone Network Management,Communications protocols and Standards, Case Histories of Networking and Management, Challenges ofInformation Technology Managers, Network Management: Goals, Organization, and Functions, Network and System Management, Network Management System Platform, Current Status and future of Network Management.		
UNIT – II	**SNMPV1 Network Management**	**Hours: 09**
Organization, Information and communication Models – ASN.1.Managed network: Case Histories and Examples, The History of SNMP Management, The SNMP Model, The Organization Model, System Overview, The Information Model.SNMPv1 Network Management: Communication and Functional Models. The SNMP Communication Model,Functional model.		
UNIT – III	**SNMP Management: SNMPV2 and RMON**	**Hours: 09**
Major Changes in SNMPv2, SNMPv2 System Architecture, SNMPv2 Structure of Management Information, SNMPv2 Management Information Base, SNMPv2 Protocol, Compatibility withSNMPv1. RMON: Introduction - RMON SMI and MIB, RMON1, RMON2 - A Case Study of Internet Traffic Using RMON.		
UNIT – IV	**Telecommunications Management Network, Network Management Tools and Systems**	**Hours: 09**
Introduction - Operations Systems,TMN Conceptual Model, TMN Standards, TMN Architecture, TMN Management Service Architecture, An Integrated View of TMN,I mplementation Issues. Network Management Tools, Network Statistics Measurement Systems, History of Enterprise Management, Network Management systems, Commercial Network management Systems, System Management, Enterprise Management Solutions.		
UNIT – V	**Web-Based Management**	**Hours: 09**
NMS with Web Interface and Web-Based Management, Web Interface to SNMP Management, Embedded Web-Based Management, Desktop management Interface, Web-Based Enterprise Management, WBEM: Windows Management Instrumentation,Java management Extensions, Management of a Storage Area Network: , Future Direction.		

Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**	**Total Hours: 60**

Text Books:

1. Mani Subramanian, Network Management, Principles and Practice , Pearson Education, 2010.

Reference Books:

1. J. Richard Burke, Network Management–Concepts and Practice: A Hands-on Approach , PHI, 2008.
2. Mark Burgess, Principles of Network and System Administration , Wiley, 2002.

Websites :

1. http://nptel.ac.in/courses/106105081/

Department : Computer Science and Engineering		**Programme :** M.Tech. (Distributed Systems)						
Semester :		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CSE63	Search Engine Optimization	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• Acquire a knowhow to optimize each a page in a web site. • Get an overview of various important search engines and directories. • Know about web design elements to ensure a site is search engine compatible.							
Outcome	On successful completion of the course, students will be able to: • Knowledge about good Search keywords to get optimized search. • Knowledge about how to design web page so as to get top page rank.							
UNIT – I	**Search Engine Basics**							**Hours: 09**
Search Engine Basics- Importance of Internet Marketing, its Types and Methods - Working of Search Engines- Search Engine Optimization - Basic Understanding of SERP, Search Operators, Search Engine Architecture-- Search Engine Algorithms and their Updates - Page Rank Technology - Web Masters Tool								
UNIT – II	**Keywords Search**							**Hours: 09**
Introduction to Keyword Research -Business Analysis -Types of Keywords -Keyword Research Methodology- Keywords Analysis Tools-Competition Analysis-Preparing a Keyword List for Project -Localized Keywords Research								
UNIT – III	**On-Page Optimization**							**Hours: 09**
Website Designing and Development Basics: HTML based **SEO** Basics-Basics of Onsite Optimization -Importance of Domain Names and their Selection - Optimization of Website Structure and Navigation Menu - Filename and Title Tag Optimization - Keyword Research and Density Analysis - Knowledge of Meta Tags and its Optimization - Content Optimization -Page Speed and Anchor Links Optimization - Header and Footer Optimization – Canonical - Implementation and many more								
UNIT – IV	**Off Page Optimization**							**Hours: 09**
Basic Introduction- Subsequent Promotion of Web Pages - Directory and Blog Submissions - Link Building Methods and Types - Free Classifieds, Forums, Press Releases, Forum Signatures and Commenting - Social Book marking and Business Listing -Classified Posting, Blog Commenting, Press Release and Article Submissions -Video and RSS Feed Submissions - Basics of Social Media Optimization (SMO) -Link and Page Rank Tracking								
UNIT – V	**SEO For Dynamic Websites**							**Hours: 09**
Difference between Static and Dynamic Websites - Search Engine Optimization for Word Press -Search Engine Optimization for Joomla -Search Engine Optimization for Blogspot- Optimization of Flash Websites. Traffic Analysis -Use of Google Analytics - Tracking and Improving Conversions								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**			**Total Hours: 60**			
Text Books:								
1. Introduction to Search Engine Optimization - Getting Started With SEO to Achieve Business Goals , Hubspot								
Reference Books:								
1. Search Engine Optimization Book, Aaron Matthew Wall 2. Search Engine Optimization An Hour a Day, Jennifer Grappone Gradiva Couzin Wiley Publishing Inc. 3. The Basics of Search Engine Optimisation ,David Burdon and Simply Clicks ,June 2005								
Websites:								
-								

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Semester :		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CSE64	Text Data Mining	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To appreciate the different aspects of text categorization and clustering • To understand the role played by text mining in Information retrieval and extraction • To appreciate the use of probabilistic models for text mining							
Outcome	On successful completion of the course, students will be able to: • Use available open source classification and clustering tools on standard text datasets. • Modify existing classification/clustering algorithms in terms of functionality or features used. • Design a system that uses text mining to improve the functions of an existing open source search engine.							

UNIT – I	**Overview of Text Mining**	**Hours: 09**

Definition-General Architecture–Algorithms–Core Operations –Pre-processing–Types of Problems-basics of document classification-information retrieval-clustering and organizing documents-information extraction prediction and evaluation-Textual information to numerical vectors -Collecting documents-document standardization-tokenization-lemmatization-vector generation for prediction-sentence boundary determination -evaluation performance

UNIT – II	**Text Categorization and Clustering**	**Hours: 09**

Text Categorization –Definition –Document Representation –Feature Selection -Decision Tree Classifiers -Rule-based Classifiers -Probabilistic and Naive Bayes Classifiers -Linear Classifiers-Classification of Linked and Web Data-Meta-Algorithms–Clustering –Definition-Vector Space Models -Distance-based Algorithms-Word and Phrase-based Clustering -Semi-Supervised Clustering -Transfer Learning

UNIT – III	**Text Mining for Information Retrieval and Information Extraction**	**Hours: 09**

Information retrieval and text mining -keyword search-nearest-neighbor methods -similarity-web-based document search-matching-inverted lists -evaluation. Information extraction -Architecture –Co-reference -Named Entity and Relation Extraction -Template filling and database construction Applications. Inductive -Unsupervised Algorithms for Information Extraction. Text Summarization Techniques -Topic Representation -Influence of Context -Indicator Representations -Pattern Extraction -Apriori Algorithm -FP Tree algorithm

UNIT – IV	**Probabilistic Models**	**Hours: 09**

Probabilistic Models for Text Mining -Mixture Models -Stochastic Processes in Bayesian Nonparametric Models -Graphical Models -Relationship Between Clustering, Dimension Reduction and Topic Modeling -Latent Semantic Indexing -Probabilistic Latent Semantic Indexing -Latent Dirichlet Allocation -Interpretation and Evaluation -Probabilistic Document Clustering and Topic Models -Probabilistic Models for Information Extraction -Hidden Markov Models -Stochastic Context- Free Grammars - Maximal Entropy Modeling -Maximal Entropy Markov Models -Conditional Random Fields

UNIT – V	**Recent Trends**	**Hours: 09**

Visualization Approaches -Architectural Considerations -Visualization Techniques in Link Analysis -Example-Mining Text Streams -Text Mining in Multimedia -Text Analytics in Social Media -Opinion Mining and Sentiment Analysis -Document Sentiment Classification -Opinion Lexicon Expansion -Aspect -Based Sentiment Analysis -Opinion Spam Detection –Text Mining Applications and Case studies

Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**	**Total Hours: 60**

Text Books:

1. Ronen Feldman, James Sanger, The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data , Cambridge University press, 2006.
2. Weiss, S.M., Indurkhya, N., Zhang, T., Damerau, F.Text Mining Predictive Methods for Analyzing Unstructured Information, Springer 2004.
3. Charu C. Aggarwal, ChengXiang Zhai ,Mining Text Data, Springer, 2012.

Reference Books:

1. Sholom M. Weiss, Nitin Indurkhya and Tong Zhang, Fundamentals of Predictive Text Mining (Texts in Computer Science) Springer, 2012.

Websites:

1. http://nptel.ac.in/courses/106106093/35
2. http://nptel.ac.in/syllabus/106101007/

Department : Computer Science and Engineering		**Programme :** M.Tech. (Distributed Systems)						
Semester :		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CSE65	Social Network Analytics	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	The students are to • Understand the social network concepts and various methods of analysis. • Understand the underlying mathematical structures of Social Networks. • Get an overview of the structural properties of Social Networks.							
Outcome	At the end of the course the students will be able to: • Understand the data in the Social Network way. • Identify, formulate and analyze Social network problems and interpret the results obtained.							
UNIT – I	**Network, Relations and Structure**							**Hours: 09**
The Social Networks Perspective- Network Data- Boundary Specification and Sampling- Types of Networks- Network Data, Measurement and Collection								
UNIT – II	**Mathematical Representations of Social Networks**							**Hours: 09**
Graph Theoretic Notation- Sociometric Notation- Algebraic Notation- Graphs- Directed Graphs- Signed Graphs- Signed Directed Graphs- Valued Graphs- Valued Directed Graphs- Multi Graphs- Hyper Graphs- Relations- Matrices- Properties								
UNIT – III	**Structural and Locational Properties**							**Hours: 09**
Actor Centrality- Degree Centrality- Closeness Centrality- Betweenness Centrality- Information Centrality- Structural Balance- Clusterability- Generalizations of Clusterability- Transitivity								
UNIT – IV	**Roles and Positions**							**Hours: 09**
Background- Structural Equivalence- Automorphic and Isomorphic Equivalence- Regular Equivalence- Types of Ties- Local Role Equivalence- Ego Algebras								
UNIT – V	**Dyadic and Triadic Methods**							**Hours: 09**
The Dyad Census- The Example and Its Dyad Census- An Index for Mutuality- Simple Distributions on Digraphs- Conditional Uniform Distributions- The Triad Census- The Example and Its Triad Census- Mean and Variance of a Triad Census								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**			**Total Hours: 60**			

Text Books:

1. John Scott ,Social Network Analysis – A Handbook , SAGE Publications, 2nd Edition,2000.

Reference Books:

1. Stanley Wasserman and Katherine Faust, Social Network Analysis – Methods and Applications, Cambridge University Press,1994.
2. David Knoke and Song Yang, Social Network Analysis, SAGE Publications, 2nd Edition,2007.

Websites:

1. Social Network Analysis Theory and Applications by available at http://train.ed.psu.edu/WFED-543/SocNet_TheoryApp.pdf
2. Introduction to social network methods by Robert A. Hanneman and Mark Riddle available at http://faculty.ucr.edu/~hanneman/nettext/

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Semester :		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CSE66	Geographical Information System	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• Basic understanding of spatial phenomena and fundamentals of GIS • The quantitative analysis and qualitative analysis of spatial and attribute information in a GIS database. • Capacity to understand possibilities and constrains related to GIS							
Outcome	On completion of this course, students will be able to • Deep theoretical knowledge about how to capture, import, structure, analyze and present geographical data • Apply GIS analyses to address geospatial problems. • Provide a spatial visualization capability for analyzing descriptive characteristics about geographical features.							
UNIT – I	**Introduction**							**Hours: 09**
The nature of GIS – The Real World and representations of it – Geographic Information Systems – Stages of Spatial Data handling - Database Management Systems - GIS and spatial databases – Structure of this book.								
UNIT – II	**Geographic Information and Spatial Data Types**							**Hours: 09**
Models and representations of Real World – Geographic Phenomena – Computer Representations of Geographic Information – Organizing and Managing Spatial Data – The Temporal Dimensions.								
UNIT – III	**Data Entry and Preparation**							**Hours: 09**
Spatial Data Input – Spatial Referencing - Data Quality – Data Preparation – Point Data Preparation – Advanced Operations on Continuous Field Rasters.								
UNIT – IV	**Spatial Data Analysis**							**Hours: 09**
Classification of analytical GIS capabilities – Retrieval, classification and measurement – Overlay functions – Neighborhood functions – Network Analysis – GIS and application models – Error propagation in spatial data processing.								
UNIT – V	**Data Visualization**							**Hours: 09**
GIS and Maps – The visualization process – Visualization strategies: present or explore? – How to Map – Map cosmetics – Map dissemination								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes:**			**Total Hours: 60**			
Text Books:								
1. Otto Huisman and Rolf A. de, Principles of Geographic Information Systems , 4th Edition – International Institute for Geo-Information Science and Earth Observation, ITC Educational Textbook series, International Edition 2009.								
Reference Books:								
1. David J. Buckley, An introduction to Geographic Information System , February 1997. 2. Andy Schmitz, Essentials of Geographic Information Systems , 2012.								
Website:								
1. http://geomatica.como.polimi.it/corsi/geog_info_system/l2_introduction_GIS.pdf								

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Semester :		**Category : TY**						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CSE67	Internals of Operating System	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To identify the necessity of various sub systems in UNIX operating system. • To analyze the mechanism of process communication and the differences in the organization of Unix and Windows operating systems • To design various data structures needed to develop an operating system							
Outcome	On successful completion of the course, the students will be able to: • Explain the components in Unix and Windows operating system • Use the system calls whenever they are necessary • Know the storage of information of system usage and other information in Windows system and develop the algorithms to perform kernel functions • Appreciate the appropriateness of various data structures used to store data related to process and files							
UNIT – I	**Buffer Cache and File Sub-System**							**Hours: 09**
Introduction to Kernel - Architecture of the UNIX operating system, System concepts, Data structures. Buffer Cache: Buffer header, Structure of Buffer pool, Reading and writing disk blocks. Files INODES, Structure of a regular file, Directories, Super block, Inode assignment.								
UNIT – II	**System Calls and Process Sub-System**							**Hours: 09**
System calls - OPEN, Read, Close, Write, Create, CHMOD, CHOWN, Pipes, Mounting and Unmounting. Process - Layout the system memory, Context, Process control, process creation, signals, Process scheduling, time, clock.								
UNIT – III	**Inter-Process Communications**							**Hours: 09**
Inter-Process Communications - Process tracing, System V IPC, Shared Memory, Semaphores. Network Communications - Socket programming: Sockets, descriptors, Connections, Socket elements, Stream and Datagram Sockets.								
UNIT – IV	**Windows System Components**							**Hours: 09**
Windows Operating system - versions, Concepts and tools, Windows internals, System Architecture, Requirements and design goals, Operating system model, Architecture overview, Key system components. System mechanisms - Trap dispatching, object manager, Synchronization, System worker threads, Windows global flags, Local procedural calls, Kernel event tracing.								
UNIT – V	**Registry and Process Management**							**Hours: 09**
Windows Management Mechanisms - The registry, Registry usage, Registry data types, Local structure, Trouble shooting Registry problems, Registry Internals, Services, Applications, Accounts, Service control Manager, Windows Management Instrumentation, Processes, Threads, and Jobs: Process Internals, Flow of create process, Thread Internals, Examining Thread creation, Thread Scheduling, Job Objects.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**			**Total Hours: 60**			

Text Books:

1. Maurice J. Bach, The Design of the Unix Operating System, Prentice Hall of India, 1991
2. Mark E. Russinovich and David A. Solomon, Microsoft® Windows® Internals, 4th Edition, Microsoft Press, 2004.

Reference Books:

1. William Stallings, Operating Systems: Internals and Design Principles , 5th Edition, Prentice Hall, 2005.

Websites:

1. https://technet.microsoft.com/en-in/sysinternals/bb963901.aspx
2. https://social.microsoft.com/Forums/en-us/home?category=windowsacademic
3. https://www.gnu.org/
4. http://www.linux.com/directory/Distributions/desktop
5. http://www.ubuntu.com/download
6. https://www.suse.com/download-linux/

Department : Computer Science and Engineering		**Programme :** M.Tech. (Distributed Systems)						
Semester :		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CSE68	Distributed System Security	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To understand the various threats, vulnerabilities, solutions and security standards for each layers of distributed systems • To understand the secure software development lifecycle process for distributed systems • To know the emerging area of Usercentric Identity Management and Identity-Based Encryption							
Outcome	On successful completion of the course students will be able to: • Structure and design the distributed systems using multiple levels of security and protection • Have knowledge on the threats, vulnerabilities and solution at various level of distributed systems							

UNIT – I	**Hours: 09**
Introduction: – Distributed Systems, Distributed Systems Security. Security in Engineering: Secure Development Lifecycle Processes - A Typical Security Engineering Process - Security Engineering Guidelines and Resources. Common Security Issues and Technologies: Security Issues, Common Security Techniques.	
UNIT – II	**Hours: 09**
Host-level Threats and Vulnerabilities: Transient code Vulnerabilities - Resident Code Vulnerabilities - Malware: Trojan Horse – Spyware - Worms/Viruses – Eavesdropping - Job Faults - Resource Starvation - Overflow - Privilege Escalation - Injection Attacks. Infrastructure-Level Threats and Vulnerabilities: Network-Level Threats and Vulnerabilities - Grid Computing Threats and Vulnerabilities – Storage Threats and Vulnerabilities – Overview of Infrastructure Threats and Vulnerabilities.	
UNIT – III	**Hours: 09**
Application-Level Threats and Vulnerabilities: Application-Layer Vulnerabilities -Injection Vulnerabilities - Cross-Site Scripting (XSS) - Improper Session Management - Improper Error Handling - Improper Use of Cryptography - Insecure Configuration Issues - Denial of Service - Canonical Representation Flaws - Overflow Issues. Service-Level Threats and Vulnerabilities: SOA and Role of Standards - Service-Level Security Requirements - Service-Level Threats and Vulnerabilities - Service-Level Attacks - Services Threat Profile.	
UNIT – IV	**Hours: 09**
Host-Level Solutions: Sandboxing – Virtualization - Resource Management - Proof-Carrying Code -Memory Firewall – Antimalware. Infrastructure-Level Solutions: Network-Level Solutions - Grid-Level Solutions - Storage-Level Solutions. Application-Level Solutions: Application-Level Security Solutions.	
UNIT – V	**Hours: 09**
Service-Level Solutions: Services Security Policy - SOA Security Standards Stack – Standards in Dept - Deployment Architectures for SOA Security - Managing Service-Level Threats - Compliance in Financial Services - SOX Compliance - SOX Security Solutions - Multilevel Policy-Driven Solution Architecture - Case Study: Grid - The Financial Application - Security Requirements Analysis. Future Directions - Cloud Computing Security – Security Appliances – Usercentric Identity Management - Identity-Based Encryption (IBE) - Virtualization in Host Security.	

Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**	**Total Hours: 60**

Text Books:

1. Abhijit Belapurkar, Anirban Chakrabarti, Harigopal Ponnapalli, Niranjan Varadarajan, Srinivas Padmanabhuni and Srikanth Sundarrajan, Distributed Systems Security: Issues, Processes and Solutions, Wiley Pubilications, First Edition, 2009.

Reference Books:

1. Yang Xiao and Yi Pan, Security in Distributed and Networking Systems, World Scientific Publishing Company, 2007.
2. Rachid Guerraoui and Franck Petit, Stabilization, Safety, and Security of Distributed Systems, Springer, 2010.

Websites:

1. http://arxiv.org/ftp/arxiv/papers/1211/1211.2032.pdf
2. http://www.sans.org/reading-room/whitepapers/application/distributed-systems-security-java-corba-

com-plus-28
3. http://www.nr.no/~abie/security.htm

Department : Computer Science and Engineering		**Programme :** M.Tech. (Distributed Systems)						
Semester :		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CSE69	Ethical Hacking	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To immerse the students into an interactive environment where they will be shown how to scan, test, hack and secure their own systems • To give students in-depth knowledge and practical experience with the current essential security systems • To learn how intruders escalate privileges and what steps can be taken to secure a system							
Outcome	On successful completion of the course, the students will be able to: • Defend a computer against a variety of different types of security attacks using a number of hands-on techniques • Defend a LAN against a variety of different types of security attacks using a number of hands-on techniques Practice and use safe techniques on the World Wide Web							
UNIT – I	**Introduction to Ethical Hacking**							**Hours: 09**
Introduction-Importance of Security-Elements of Security-Phase of an Attack- Hacker Attacks –Hacktivism – Ethical Hackers – Computer Crimes and Implication.								
UNIT – II	**Footprints**							**Hours: 09**
Introduction – Information gathering methodology – Footprinting tools – WHOIS Tool- DNS Information tool – Locating the network range – E-mail spiders – Locating network activity – Meta Search Engines.								
UNIT – III	**Scanning and Enumeration**							**Hours: 09**
Scanning: Introduction – Objectives of scanning – Scanning methodologies – Tools - Enumeration: Introduction – Techniques – Procedures – Tools.								
UNIT – IV	**Social Engineering**							**Hours: 09**
Social Engineering: Introduction- Human weakness –Types – Human based social Engineering – Computer based social Engineering – Threats and Defense – Countermeasures- Case studies on Impersonating in Facebook, My Space and Orkut.								
UNIT – V	**System Hacking**							**Hours: 09**
Introduction – Cracking password – Password cracking websites – Password guessing Algorithms – Password cracking Tools – Countermeasure – Escalating Privileges- Executing Applications – Key loggers and spywares.								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**			**Total Hours: 60**			
Text Books:								
1. EC- Council, Ethical Hacking and Countermeasures: Attack Phases, Cengage Learning, 2009. 2. EC- Council, Ethical Hacking and Countermeasures: Threats and Defense Mechanisms, Cengage Learning, 2009.								
Reference Books:								
1. Michael T. Simpson, Hands-On Ethical Hacking and Network Defense, Cengage Learning, 2012.								
Websites:								
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Department : Computer Science and Engineering		**Programme :** M.Tech. (Distributed Systems)						
Semester :		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CSE70	Embedded Systems	3	1	-	4	40	60	100
Prerequisite:	-							
Objectives	• To provide a clear understanding on the basic concepts, ARM processor and Architecture • To introduce on Embedded Process development Environment • To study on Basic of Processes and Operating systems							
Outcomes	On successful completion of the course, the students will be able to: • Have skills in the Embedded C Programming • Design Embedded System with real time constraints							
UNIT – I								**Hours: 09**
Embedded Computing - Challenges of Embedded Systems – Embedded system design process - Processor in Embedded System – Other Hardware Units in the Embedded System - Software Embedded into a System - ARM Architecture: ARM Design Philosophy - Registers - Program Status Register - Instruction Pipeline - Interrupts and Vector Table - Architecture Revision - ARM Processor Families.								
UNIT – II								**Hours: 09**
ARM Instruction Set - Data Processing Instructions - Addressing Modes - Branch, Load, Store Instructions - PSR Instructions - Conditional Instructions. Thumb Instruction Set - Register Usage - Other Branch Instructions - Data Processing Instructions - Single-Register and Multi Register Load-Store Instructions - Stack - Software Interrupt Instructions. ARM Programming using C: Simple C Programs using Function Calls – C-looping structures – Register allocation – Function calls – Pointer aliasing – Structures - Integer and Floating Point Arithmetic– inline functions and inline assembly– Portability issues.								
UNIT – III								**Hours: 09**
Optimizing Assembly Code - Profiling and cycle counting – instruction scheduling – Register allocation – conditional execution – looping constructs – bit manipulation – efficient switches – optimized primitives. Processes and Operating systems - Multiple tasks and processes – Context switching – Scheduling policies – Interprocess communication mechanisms – Exception and interrupt handling - Performance issues.								
UNIT – IV								**Hours: 09**
Introduction to RTOS- Meeting real time constraints –Defining RTOS - The Scheduler - Objects – Services - Characteristics of RTOS - Defining a Task - Tasks States and Scheduling - Task Operations – Structure – Synchronization - Communication and Concurrency. Defining Semaphores - Operations and Use - Defining Message Queue - States – Content – Storage - Operations and Use.								
UNIT – V								**Hours: 09**
Embedded System Development - Multi-state systems and function sequences. Embedded software development tools – Emulators and debuggers. Design methodologies – Case studies – Windows CE – Linux 2.6x and RTLinux – Coding and sending application layer byte stream on a TCP/IP network using RTOS Vxworks – Embedded system for a smart card.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**			**Total Hours: 60**			
Text Books:								
1. Andrew N Sloss, D. Symes and C. Wright, ARM System Developers Guide, Morgan Kaufmann / Elsevier, 2006. 2. Raj Kamal, Embedded Systems – Architecture, Programming and Design, 2nd Edition, McGraw-Hill companies, 2008. 3. Qing Li, Real Time Concepts for Embedded Systems, Elsevier, 2011.								
Reference Books:								
1. Michael J. Pont, Embedded C, Pearson Education, 2007. 2. Wayne Wolf, Computers as Component: Principles of Embedded Computer System Design, 2nd Edition, 2008. 3. Steve Heath, Embedded System Design, Elsevier, 2nd Edition, 2003.								
Websites: -								