**PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)**

| PEO No. | PEO Caption | PEOs |
|---|---|---|
| **1.** | **Core competency** | To apply their basic knowledge in Mathematics, Science and Engineering and to expose to the recent Information Technologies to analyze and solve real world problems. |
| **2.** | **Innovation** | To be competent in the IT segments and to bring out novel ideas by exploring the multiple solutions for the given problem. |
| **3.** | **Adaptive Learning** | To engage in sustained learning for the career opportunities in industries, research divisions, and academics so that they can adapt to ever-changing technological and societal requirements. |
| **4.** | **Team spirit** | To mould the students to be ethically committed towards team work for producing quality output with the aim of developing our nation. |

**PROGRAMME OUTCOMES (POS)**

| PO Number | POs |
|---|---|
| 1. | An ability to apply knowledge of mathematics, science and information science in advance level |
| 2. | An ability to design a Information system with components and processes to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability |
| 3. | An ability to identify and modify the functions of the internals of information processing system |
| 4. | An ability to apply Software Engineering principles, techniques and tools in software development |
| 5. | An ability to create, collect, process, view, organize, store, mine and retrieve information both in local and remote locations in a secure and effective manner |
| 6. | An ability to design and conduct experiments, as well as to analyze and interpret information to lay a foundation for solving complex problems |
| 7. | An ability to engage in life-long learning to acquire knowledge of contemporary issues in IT domain to meet the challenges in the career |
| 8. | An ability to apply the skills and techniques in information technology and inter-disciplinary domains for providing solutions in a global, economic, environmental, and societal context |
| 9. | An ability to develop IT research skills and innovative ideas |
| 10. | An ability to model the IT real world problems and to address and share the research issues |
| 11. | An ability to share their IT knowledge and express their ideas in any technical forum |
| 12. | An ability to present their ideas to prepare for a position to educate and guide others |

**AFFILIATED INSTITUTIONS**

**ANNA UNIVERSITY, CHENNAI**

**REGULATIONS - 2013**

**M.TECH. INFORMATION TECHNOLOGY**

**I TO IV SEMESTERS CURRICULA AND SYLLABI (FULL TIME)**

**SEMESTER I**

| SL. NO | COURSE CODE | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| **THEORY** | | | | | | |
| 1. | MA7155 | Applied Probability and Statistics | 3 | 1 | 0 | 4 |
| 2. | CP7102 | Advanced Data Structures and Algorithms | 3 | 0 | 0 | 3 |
| 3. | CP7103 | Multicore Architectures | 3 | 0 | 0 | 3 |
| 4. | IF7101 | Internetworking Technologies | 3 | 0 | 0 | 3 |
| 5. | IF7102 | Object Oriented Software Engineering | 3 | 0 | 0 | 3 |
| 6. | CP7202 | Advanced Databases | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | | |
| 7. | IF7111 | Advanced Data Structures Laboratory | 0 | 0 | 3 | 2 |
| 8. | IF7112 | Internetworking Laboratory | 0 | 0 | 3 | 2 |
| 9 | IF7113 | Mini Project | 0 | 0 | 2 | 1 |
| | | **TOTAL** | **18** | **1** | **8** | **24** |

**SEMESTER II**

| SL. NO | COURSE CODE | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| **THEORY** | | | | | | |
| 1. | IF7201 | Web Technologies | 3 | 0 | 0 | 3 |
| 2. | IF7202 | Cloud Computing | 3 | 0 | 0 | 3 |
| 3. | NE7202 | Network and Information Security | 3 | 0 | 0 | 3 |
| 4. | IF7203 | Data Warehousing and Data Mining | 3 | 0 | 0 | 3 |
| 5. | | Elective I | 3 | 0 | 0 | 3 |
| 6. | | Elective II | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | | |
| 7. | IF7211 | Web Technology Laboratory | 0 | 0 | 3 | 2 |
| 8. | IF7212 | Cloud Computing Laboratory | 0 | 0 | 3 | 2 |
| 9 | IF7213 | Technical Seminar | 0 | 0 | 2 | 1 |
| | | **TOTAL** | **18** | **0** | **8** | **23** |

**SEMESTER III**

| SL. NO | COURSE CODE | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| **THEORY** | | | | | | |
| 1. | IF7301 | Soft Computing | 3 | 0 | 0 | 3 |
| 2. | | Elective III | 3 | 0 | 0 | 3 |
| 3. | | Elective IV | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | | |
| 1. | IF7311 | Project Work (Phase I) | 0 | 0 | 12 | 6 |
| | | **TOTAL** | **9** | **0** | **12** | **15** |

**SEMESTER IV**

| SL. NO | COURSE CODE | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| **PRACTICAL** | | | | | | |
| 1. | IF7411 | Project Work (Phase II) | 0 | 0 | 24 | 12 |
| | | **TOTAL** | **0** | **0** | **24** | **12** |

**TOTAL NO. OF CREDITS:74**

## LIST OF ELECTIVES

### ELECTIVE I

| SL. NO | COURSE CODE | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| 1. | IF7001 | Software Metrics and Reliability | 3 | 0 | 0 | 3 |
| 2. | NE7007 | Network Management | 3 | 0 | 0 | 3 |
| 3. | IF7002 | Bio Informatics | 3 | 0 | 0 | 3 |
| 4. | MP7001 | XML and Web Services | 3 | 0 | 0 | 3 |
| 5. | CP7028 | Enterprise Application Integration | 3 | 0 | 0 | 3 |
| 6. | IF7003 | Video Analytics | 3 | 0 | 0 | 3 |

### ELECTIVE II

| | | | | | | |
|---|---|---|---|---|---|---|
| 7. | IF7004 | Software Project Management | 3 | 0 | 0 | 3 |
| 8. | NE7002 | Mobile and Pervasive Computing | 3 | 0 | 0 | 3 |
| 9. | CP7203 | Principles of Programming Languages | 3 | 0 | 0 | 3 |
| 10. | IF7005 | Multimedia Technologies | 3 | 0 | 0 | 3 |
| 11. | IF7006 | Automata Theory and Compiler Design | 3 | 0 | 0 | 3 |
| 12. | SE7204 | Big Data Analytics | 3 | 0 | 0 | 3 |

### ELECTIVE III

| | | | | | | |
|---|---|---|---|---|---|---|
| 13. | IF7007 | Software Quality and Testing | 3 | 0 | 0 | 3 |
| 14. | NC7202 | Wireless Adhoc and Sensor Networks | 3 | 0 | 0 | 3 |
| 15. | IF7008 | Web Mining | 3 | 0 | 0 | 3 |
| 16. | IF7009 | Image Processing and Pattern Analysis | 3 | 0 | 0 | 3 |
| 17. | IF7010 | Intelligent Agents | 3 | 0 | 0 | 3 |
| 18. | IF7011 | Internet of Things | 3 | 0 | 0 | 3 |
| 19. | NE7003 | Web Engineering | 3 | 0 | 0 | 3 |

### ELECTIVE IV

| | | | | | | |
|---|---|---|---|---|---|---|
| 20. | CP7006 | Parallel Programming Paradigms | 3 | 0 | 0 | 3 |
| 21. | NE7012 | Social Network Analysis | 3 | 0 | 0 | 3 |
| 22. | IF7012 | Knowledge Engineering | 3 | 0 | 0 | 3 |
| 23. | IF7013 | Energy Aware Computing | 3 | 0 | 0 | 3 |
| 24. | IF7014 | 4G Technologies | 3 | 0 | 0 | 3 |
| 25. | CP7001 | Performance Evaluation of Computer Systems | 3 | 0 | 0 | 3 |

**MA7155 APPLIED PROBABILITY AND STATISTICS L T P C**
**3 1 0 4**

**OBJECTIVES:**

- To introduce the basic concepts of one dimensional and two dimensional Random Variables.
- To provide information about Estimation theory, Correlation, Regression and Testing of hypothesis.
- To enable the students to use the concepts of multivariate normal distribution and principle components analysis.

**UNIT I ONE DIMENSIONAL RANDOM VARIABLES 9+3**

Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Functions of a Random Variable.

**UNIT II TWO DIMENSIONAL RANDOM VARIABLES 9+3**

Joint distributions – Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve – Correlation.

**UNIT III ESTIMATION THEORY 9+3**

Unbiased Estimators – Method of Moments – Maximum Likelihood Estimation - Curve fitting by Principle of least squares – Regression Lines.

**UNIT IV TESTING OF HYPOTHESES 9+3**

Sampling distributions - Type I and Type II errors - Tests based on Normal, t, Chi-Square and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit.

**UNIT V MULTIVARIATE ANALYSIS 9+3**

Random Vectors and Matrices - Mean vectors and Covariance matrices - Multivariate Normal density and its properties - Principal components Population principal components - Principal components from standardized variables.

**TOTAL 45+15:60 PERIODS**

**OUTCOMES:**

- The student will able to acquire the basic concepts of Probability and Statistical techniques for solving mathematical problems which will be useful in solving Engineering problems

**REFERENCES:**


1 Jay L. Devore, “Probability and Statistics For Engineering and the Sciences”, Thomson and Duxbury, 2002.
2. Richard Johnson. ”Miller & Freund’s Probability and Statistics for Engineer”, Prentice – Hall , Seventh Edition, 2007.
3. Richard A. Johnson and Dean W. Wichern, “Applied Multivariate Statistical Analysis”, Pearson Education, Asia, Fifth Edition, 2002.
4. Gupta S.C. and Kapoor V.K.”Fundamentals of Mathematical Statistics”, Sultan an Sons, 2001.
5. Dallas E Johnson , “Applied Multivariate Methods for Data Analysis”, Thomson and Duxbury press,1998.

**CP7102 ADVANCED DATA STRUCTURES AND ALGORITHMS L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To understand the principles of iterative and recursive algorithms.
- To learn the graph search algorithms.
- To study network flow and linear programming problems.
- To learn the hill climbing and dynamic programming design techniques.
- To develop recursive backtracking algorithms.
- To get an awareness of NP completeness and randomized algorithms.
- To learn the principles of shared and concurrent objects.
- To learn concurrent data structures.

**UNIT I ITERATIVE AND RECURSIVE ALGORITHMS 9**

Iterative Algorithms: Measures of Progress and Loop Invariants-Paradigm Shift: Sequence of Actions versus Sequence of Assertions- Steps to Develop an Iterative Algorithm-Different Types of Iterative Algorithms--Typical Errors-Recursion-Forward versus Backward- Towers of Hanoi-Checklist for Recursive Algorithms-The Stack Frame-Proving Correctness with Strong Induction-Examples of Recursive Algorithms-Sorting and Selecting Algorithms-Operations on Integers-Ackermann's Function- Recursion on Trees-Tree Traversals- Examples- Generalizing the Problem - Heap Sort and Priority Queues-Representing Expressions.

**UNIT II OPTIMISATION ALGORITHMS 9**

Optimization Problems-Graph Search Algorithms-Generic Search-Breadth-First Search-Dijkstra's Shortest-Weighted-Path -Depth-First Search-Recursive Depth-First Search-Linear Ordering of a Partial Order- Network Flows and Linear Programming-Hill Climbing-Primal Dual Hill Climbing-Steepest Ascent Hill Climbing-Linear Programming-Recursive Backtracking-Developing Recursive Backtracking Algorithm- Pruning Branches-Satisfiability

**UNIT III DYNAMIC PROGRAMMING ALGORITHMS 9**

Developing a Dynamic Programming Algorithm-Subtle Points- Question for the Little Bird-Subinstances and Subsolutions-Set of Subinstances-Decreasing Time and Space-Number of Solutions-Code. Reductions and NP-Completeness**-**Satisfiability-Proving NP-Completeness- 3-Coloring- Bipartite Matching. Randomized Algorithms**-**Randomness to Hide Worst Cases-Optimization Problems with a Random Structure.

**UNIT IV SHARED OBJECTS AND CONCURRENT OBJECTS 9**

Shared Objects and Synchronization -Properties of Mutual Exclusion-The Moral -The Producer–Consumer Problem -The Readers–Writers Problem-Realities of Parallelization-Parallel Programming- Principles- Mutual Exclusion-Time- Critical Sections--Thread Solutions-The Filter Lock-Fairness-Lamport's Bakery Algorithm-Bounded Timestamps-Lower Bounds on the Number of Locations-Concurrent Objects- Concurrency and Correctness-Sequential Objects-Quiescent Consistency- Sequential Consistency-Linearizability- Formal Definitions- Progress Conditions- The Java Memory Model

**UNIT V CONCURRENT DATA STRUCTURES 9**

Practice-Linked Lists-The Role of Locking-List-Based Sets-Concurrent Reasoning- Coarse-Grained Synchronization-Fine-Grained Synchronization-Optimistic Synchronization- Lazy Synchronization-Non-Blocking Synchronization-Concurrent Queues and the ABA Problem-Queues-A Bounded Partial Queue-An Unbounded Total Queue-An Unbounded Lock-Free Queue-Memory Reclamation and the ABA Problem- Dual Data Structures- Concurrent Stacks and Elimination- An Unbounded Lock-Free Stack- Elimination-The Elimination Backoff Stack.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon completion of the course, the students will be able to

1. Design and apply iterative and recursive algorithms.
2. Design and implement optimisation algorithms in specific applications.
3. Design appropriate shared objects and concurrent objects for applications.
4. Implement and apply concurrent linked lists, stacks, and queues.

**REFERENCES:**


1. Jeff Edmonds, “How to Think about Algorithms”, Cambridge University Press, 2008.
2. M. Herlihy and N. Shavit, “The Art of Multiprocessor Programming”, Morgan Kaufmann, 2008.
3. Steven S. Skiena, “The Algorithm Design Manual”, Springer, 2008.
4. Peter Brass, “Advanced Data Structures”, Cambridge University Press, 2008.
5. S. Dasgupta, C. H. Papadimitriou, and U. V. Vazirani, “Algorithms” , Mc GrawHill, 2008.
6. J. Kleinberg and E. Tardos, "Algorithm Design“, Pearson Education, 2006.
7. T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein, “Introduction to Algorithms“, PHI Learning Private Limited, 2012.
8. Rajeev Motwani and Prabhakar Raghavan, “Randomized Algorithms”, Cambridge University Press, 1995.
9. A. V. Aho, J. E. Hopcroft, and J. D. Ullman, “The Design and Analysis of Computer Algorithms**”,** Addison-Wesley, 1975.
10. A. V. Aho, J. E. Hopcroft, and J. D. Ullman,”Data Structures and Algorithms”, Pearson,2006.


**CP7103 MULTICORE ARCHITECTURES L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To understand the recent trends in the field of Computer Architecture and identify performance related parameters
- To appreciate the need for parallel processing
- To expose the students to the problems related to multiprocessing
- To understand the different types of multicore architectures
- To expose the students to warehouse-scale and embedded architectures

**UNIT I FUNDAMENTALS OF QUANTITATIVE DESIGN AND ANALYSIS 9**

Classes of Computers – Trends in Technology, Power, Energy and Cost – Dependability – Measuring, Reporting and Summarizing Performance – Quantitative Principles of Computer Design – Classes of Parallelism - ILP, DLP, TLP and RLP - Multithreading - SMT and CMP Architectures – Limitations of Single Core Processors - The Multicore era – Case Studies of Multicore Architectures.

**UNIT II DLP IN VECTOR, SIMD AND GPU ARCHITECTURES 9**

Vector Architecture - SIMD Instruction Set Extensions for Multimedia – Graphics Processing Units - Detecting and Enhancing Loop Level Parallelism - Case Studies.

**UNIT III TLP AND MULTIPROCESSORS 9**

Symmetric and Distributed Shared Memory Architectures – Cache Coherence Issues - Performance Issues – Synchronization Issues – Models of Memory Consistency - Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks.

**UNIT IV RLP AND DLP IN WAREHOUSE-SCALE ARCHITECTURES 9**

Programming Models and Workloads for Warehouse-Scale Computers – Architectures for Warehouse-Scale Computing – Physical Infrastructure and Costs – Cloud Computing – Case Studies.

**UNIT V ARCHITECTURES FOR EMBEDDED SYSTEMS 9**

Features and Requirements of Embedded Systems – Signal Processing and Enbedded Applications – The Digital Signal Processor – Embedded Multiprocessors - Case Studies.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon completion of the course, the students will be able to

- Identify the limitations of ILP and the need for multicore architectures
- Address the issues related to multiprocessing and suggest solutions
- Bring out the salient features of different multicore architectures and how they exploit parallelism
- Analyze the different types of inter connection networks
- Explore the architecture of GPUs, warehouse-scale computers and embedded processors

**REFERENCES:**


1. John L. Hennessey and David A. Patterson, " Computer Architecture – A Quantitative Approach", Morgan Kaufmann / Elsevier, 5th. edition, 2012.
2. Kai Hwang, "Advanced Computer Architecture", Tata McGraw-Hill Education, 2003
3. Richard Y. Kain, "Advanced Computer Architecture a Systems Design Approach", PHI, 2011.
4. David E. Culler, Jaswinder Pal Singh, "Parallel Computing Architecture : A Hardware/ Software Approach" , Morgan Kaufmann / Elsevier, 1997.


**IF7101 INTERNETWORKING TECHNOLOGIES L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To study the design and implementation of a socket based application using either TCP, UDP and SCTP.
- To understand SCTP sockets and its options
- To study the features of Raw Sockets
- To learn to develop the DNS
- To study the security features in socket programming
- To explore the usage of sockets options and the system calls needed to support unicast, broadcast and multicast applications
- To explore the emerging technologies in socket programming.

**UNIT I APPLICATION DEVELOPMENT 9**

Introduction to Socket Programming – Overview of TCP/IP Protocols –Introduction to Sockets – Iterative TCP programming – Iterative UDP programming – Concurrent programming – fork and exec - I/O multiplexing – I/O Models – select function – shutdown function – TCP echo Server (with multiplexing) – poll function – TCP echoClient (with Multiplexing) Multiplexing TCP and UDP sockets- Threaded servers – thread creation and termination – TCP echo server using threads – Mutexes – condition variables

**UNIT II ELEMENTARY SCTP SOCKETS AND SOCKET OPTIONS 9**

Introduction to SCTP- Interface Modules – SCTP functions- sctp_bindx, sctp_connectx, sctp_getpaddrs, sctp_freepaddrs, sctp_getladdrs, sctp_freeladdrs, sctp_sendmsg, sctp_recvmsg, sctp_opt_info, sctp_peeloff, shutdown – Notifications - Socket options – getsockopt and setsockopt functions- Socket states – generic socket options – IP socket options – ICMP socket options – TCP socket options -.SCTP socket options – fcntl functions.

**UNIT III RAW SOCKETS AND DNS 9**

Ipv4 and Ipv6 interoperability - raw sockets – raw socket creation – raw socket output – raw socket input – ping program – trace route program - Domain name system – gethostbyname function – Ipv6 support in DNS – gethostbyadr function – getservbyname and getservbyport functions – Data link Access – BPF, DLPI,libpcap, libnet.

**UNIT IV ADVANCED SOCKETS-I 9**

Routing sockets – Datalink socket address structure – Reading and writing – sysctl operations – get_ifi_info function – Interface name and index functions- Key Management sockets – Reading and writing – Dumping Security Association Database – Creating static Security Association – Dynamically maintaining SA's – Broadcasting – Broadcast addresses – Unicast versus Broadcast – (Client) Application development for broadcasting – Race conditions – Multicasting – Multicast addresses- Multicasting versus Broadcasting on a LAN – Multicasting on a WAN – Source specific Multicast – Multicast socket options – mcast_join, (Client) Application development for multicasting – Receiving IP multicast infrastructure session announcements – Sending and receiving.

**UNIT V ADVANCED SOCKETS-II 9**

Advanced UDP sockets – Receiving flags, Destination IP address and Interface index – Datagram truncation – Using UDP instead of TCP – Adding reliability to UDP – Binding interface addresses – Concurrent UDP servers – Advanced SCTP sockets – Partial delivery - Notifications – Unordered data – Binding a subset of addresses – Determining peer and local address information – Finding an association Id given an IP address – Heartbeating and Address failure – Peeling off an association – Controlling timing – Using SCTP instead of TCP – Out of band data – Signal driven I/O.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon completion of the course, the students will be able to

- Design and develop network applications using sockets system calls.
- Compare IPv4 and IPv6
- Explore the features of Stream Control Transmission Protocol (SCTP)
- Design and develop network applications using raw socket
- Design and develop Domain Name Service
- Incorporate the security features in the socket programming
- Work with various networking tools such as ping, traceroute to investigate a traffic flow in the network.
- Extend network applications for broadcasting and multicasting
- Create innovative network design by applying advanced socket concepts.

**REFERENCES:**


1. W. Richard Stevens, "Unix Network Programming Vol-I", Second Edition, Pearson Education, 1998.
2. D.E. Comer, "Internetworking with TCP/IP Vol- III", (BSD Sockets Version), Second Edition, Pearson Education, 2003.
3. Michael Donahoo, Kenneth Calvert, "TCP/IP Sockets in C, A practical guide for programmers", Second Edition, Elsevier, 2009
4. Forouzan, " TCP/IP Protocol Suite" Second Edition, Tata MC Graw Hill, 2003.

**IF7102 OBJECT ORIENTED SOFTWARE ENGINEERING L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To provide information about wider engineering issues that form the background to develop complex, evolving (software-intensive) systems
- To gain basic knowledge about object-oriented analysis and to familiarize UML concepts
- To study the requirements of various domain applications
- To design, implement and test the software in object oriented approach
- To discuss the issues in managing the software projects
- To explore the standards related to life cycle process

**UNIT I INTRODUCTION 9**

System Concepts – Software Engineering Concepts – Development Activities – Managing Software Development –Modelling with UML – Project Organization and Communication – Case Study

**UNIT II REQUIREMENT ELICITATION AND ANALYSIS 9**

Requirements Elicitation Concepts – Requirements Elicitation Activities – Managing Requirements Elicitation– Analysis Concepts – Analysis Activities – Managing Analysis - Case Study

**UNIT III SYSTEM DESIGN 9**

Decomposing the system – Overview of System Design – System Design Concepts – System Design Activities: Objects to Subsystems – System Design Activities: Addressing Design Goals – Managing System Design - Case Study

**UNIT IV OBJECT DESIGN, IMPLEMENTATION AND TESTING 9**

Object Design Overview – Reuse Concepts – Design Patterns – Reuse Activities – Managing Reuse – Interfaces Specification Concepts – Interfaces Specification Activities – Managing Object Design – Mapping Models to Code Overview – Mapping Concepts – Mapping Activities – Managing Implementation – Testing – Case Study

**UNIT V MANAGING CHANGE 9**

Rationale Management Overview – Rationale Concepts – Rationale Activities: From Issues to Decisions – Managing Rationale – Configuration Management Overview – Configuration Management Concepts – Configuration Management Activities – Managing Configuration Management – Project Management Overview – Project Management Activities – Standard for Developing Life Cycle Process (IEEE 1074) – Overview of Capability Maturity Model (CMM) – Life Cycle Models

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon Completion of the course, the students should be able to

- Apply Object Oriented Software Engineering approach in every aspect of software project
- Analyse the requirements from various domains
- Evaluate the relationships between Software Design and Software Engineering
- Adapt appropriate object oriented design aspects in the development process
- Implement and test the software project using object oriented approach
- Manage the issues regarding the decision making and changes in the different stage of software development
- Implement mini projects incorporating the principles of object oriented software engineering

**REFERENCES**:


1. Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, Pearson Education, 2011.
2. Jacobson, Ivar & Christerson, Magnus & Jonsson, Patrik & Overgaard, Gunnar "Object Oriented Software Engineering", Pearson Education, Delhi, 2007
3. Craig Larman, Applying UML and Patterns, 3rd ed, Pearson Education, 2005.


**CP7202 ADVANCED DATABASES L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To learn the modeling and design of databases.
- To acquire knowledge on parallel and distributed databases and its applications.
- To study the usage and applications of Object Oriented database
- To understand the principles of intelligent databases.
- To understand the usage of advanced data models.
- To learn emerging databases such as XML, Cloud and Big Data.
- To acquire inquisitive attitude towards research topics in databases.

**UNIT I PARALLEL AND DISTRIBUTED DATABASES 9**

Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures – Parallel Systems- Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism – Design of Parallel Systems- Distributed Database Concepts - Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query Processing – Case Studies

**UNIT II OBJECT AND OBJECT RELATIONAL DATABASES 9**

Concepts for Object Databases: Object Identity – Object structure – Type Constructors – Encapsulation of Operations – Methods – Persistence – Type and Class Hierarchies – Inheritance – Complex Objects – Object Database Standards, Languages and Design: ODMG Model – ODL – OQL – Object Relational and Extended – Relational Systems: Object Relational features in SQL/Oracle – Case Studies.

**UNIT III INTELLIGENT DATABASES 9**

Active Databases: Syntax and Semantics (Starburst, Oracle, DB2)- Taxonomy- Applications- Design Principles for Active Rules- Temporal Databases: Overview of Temporal Databases- TSQL2- Deductive Databases: Logic of Query Languages – Data log- Recursive Rules-Syntax and Semantics of Datalog Languages- Implementation of Rules and Recursion- Recursive Queries in SQL- Spatial Databases- Spatial Data Types- Spatial Relationships- Spatial Data Structures- Spatial Access Methods- Spatial DB Implementation.

**UNIT IV ADVANCED DATA MODELS 9**

Mobile Databases: Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models -Concurrency Control - Transaction Commit Protocols- Multimedia Databases- Information Retrieval- Data Warehousing- Data Mining- Text Mining.

**UNIT V EMERGING TECHNOLOGIES 9**

XML Databases: XML-Related Technologies-XML Schema- XML Query Languages- Storing XML in Databases-XML and SQL- Native XML Databases- Web Databases- Geographic Information Systems- Biological Data Management- Cloud Based Databases: Data Storage Systems on the Cloud- Cloud Storage Architectures-Cloud Data Models- Query Languages- Introduction to Big Data-Storage-Analysis.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon completion of the course, the students will be able to

- Select the appropriate high performance database like parallel and distributed database
- Model and represent the real world data using object oriented database
- Design a semantic based database to meaningful data access
- Embed the rule set in the database to implement intelligent databases
- Represent the data using XML database for better interoperability
- Handle Big data and store in a transparent manner in the cloud
- To solve the issues related to the data storage and retrieval

**REFERENCES:**


1. R. Elmasri, S.B. Navathe, “Fundamentals of Database Systems”, Fifth Edition, Pearson Education/Addison Wesley, 2007.
2. Thomas Cannolly and Carolyn Begg, “Database Systems, A Practical Approach to Design, Implementation and Management”, Third Edition, Pearson Education, 2007.
3. Henry F Korth, Abraham Silberschatz, S. Sudharshan, “Database System Concepts”, Fifth Edition, McGraw Hill, 2006.
4. C.J.Date, A.Kannan and S.Swamynathan, ”An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.
5. Raghu Ramakrishnan, Johannes Gehrke, “Database Management Systems”, McGraw Hill, Third Edition 2004.


**IF7111 ADVANCED DATA STRUCTURES LABORATORY L T P C**
**0 0 3 2**

**OBJECTIVES:**

- To learn to implement iterative and recursive algorithms.
- To learn to design and implement algorithms using hill climbing and dynamic programming techniques.
- To learn to implement shared and concurrent objects.
- To learn to implement concurrent data structures.

**LAB EXERCISES:**

Each student has to work individually on assigned lab exercises. Lab sessions could be scheduled as one contiguous four-hour session per week or two two-hour sessions per week. There will be about 15 exercises in a semester. It is recommended that all implementations are carried out in Java. If C or C++ has to be used, then the threads library will be required for concurrency. Exercises should be designed to cover the following topics:

- Implementation of graph search algorithms.
- Implementation and application of network flow and linear programming problems.
- Implementation of algorithms using the hill climbing and dynamic programming design techniques.
- Implementation of recursive backtracking algorithms.
- Implementation of randomized algorithms.
- Implementation of various locking and synchronization mechanisms for concurrent linked lists, concurrent queues, and concurrent stacks.
- Developing applications involving concurrency.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon completion of the course, the students will be able to

1. Design and apply iterative and recursive algorithms.
2. Design and implement algorithms using the hill climbing and dynamic programming and recursive backtracking techniques.
3. Design and implement optimisation algorithms for specific applications.
4. Design and implement randomized algorithms.
5. Design appropriate shared objects and concurrent objects for applications.
6. Implement and apply concurrent linked lists, stacks, and queues.

**REFERENCES:**


1. Jeff Edmonds, “How to Think about Algorithms”, Cambridge University Press, 2008.
2. M. Herlihy and N. Shavit, “The Art of Multiprocessor Programming”, Morgan Kaufmann, 2008.
3. Steven S. Skiena, “The Algorithm Design Manual”, Springer, 2008.
4. Peter Brass, “Advanced Data Structures”, Cambridge University Press, 2008.
5. S. Dasgupta, C. H. Papadimitriou, and U. V. Vazirani, “Algorithms” , McGrawHill, 2008.
6. J. Kleinberg and E. Tardos, "Algorithm Design“, Pearson Education, 2006.
7. T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein, “Introduction to Algorithms“, PHI Learning Private Limited, 2012.
8. Rajeev Motwani and Prabhakar Raghavan, “Randomized Algorithms”, Cambridge University Press, 1995.
9. A. V. Aho, J. E. Hopcroft, and J. D. Ullman, “The Design and Analysis of Computer Algorithms**”,** Addison-Wesley, 1975.
10. A. V. Aho, J. E. Hopcroft, and J. D. Ullman,”Data Structures and Algorithms”, Pearson,2006.


**IF7112 INTERNETWORKING LABORATORY L T P C**
**0 0 3 2**

**OBJECTIVES:**

- To learn network programming
- To establish connection among the system in the network.
- To analyze network traffic
- To acquire knowledge about various networking tools.

**EXERCISES:**

1. You are an employee of an XYZ company, working in its branch office and have been given the task to provide service for a valued enterprise customer. If you are unable to solve queries of the customer, obtain the help from your boss at head quarters. The nodes are installed at three different locations. One is at the customer’s headquarters, one is at their branch office and one is at a top secret R&D department. Implement the above scenario using TCP socket.

2. Develop a Client/server application in C/C++ for implementing the following scenario:
   Consider nodes A, B, C and D. Visualize Node A as the source, node B as the router. Nodes C and D are two nodes acting as two different networks connected with two interfaces of the router B. Node A should send an IP datagram to B. B extracts the network address from the destination IP of the datagram and forwards it to either C or D depending on the network address.

   **Note**: Construct IP header with proper fields. Use a static routing table in node B and suitable subnet masks for forwarding to C and D. Show the output for both Cases
   Case 1: IP datagram to node C.
   Case 2: IP datagram to node D.)

3. Simulation of DNS using UDP sockets. Consider a root server, three Top Level Domain (TLD) servers (say, corresponding to com, edu and gov), three Authoritative Servers. The client sends a DNS query to the root server. The root server sends the IP address of TLD server to the client. The client sends the DNS query to the TLD server. The TLD server sends the IP address of the authoritative server to the client. The client sends the DNS query to the authoritative server and gets the IP address of the required host. Implement this scenarios in C/C++ language
   **Note**: A domain name consists of one or more parts, technically called *labels.* Each label may contain up to 63 characters. The full domain name may not exceed a total length of 253 characters. The characters allowed in a label follow the LDH rule (letters, digits, hyphen). Domain names are interpreted in case- independent manner. Labels should not start or end with a hyphen

4. Write a C/C++ code in TCP protocol stack, which sends a SYN packet with a randomly spoofed IP to avoid the firewall blocking. This will result in all the entries in the spoofed IP list, sending RST segments to the victim server, upon getting the SYN-ACK from the victim. This can choke the target server and often form a crucial part of a Denial Of Service (**DOS**) attack. Launch the DOS attack by many hosts from various location, all target the same victim to launch Distributed DOS (**DDOS**).

5. Develop a protocol for transmitting private documents via the Internet in an encrypted form. Ensure that the information is sent, unchanged, only to the server you intended to send it to. It has to encrypt TCP/IP traffic that also incorporates authentication and data integrity. It may run on top of TCP/IP. It is based on session-key encryption. It adds a number of extra features, including authentication based on X.509 certificates and integrity checking with message authentication codes. It is an extension of sockets, which allow a client and a server to establish a stream of communication with each other in a secured manner. They begin with a handshake, which allows identities to be established and keys to be exchanged. Show that the developed protocol protects a network from attacks such as IP spoofing, IP source routing, and DNS spoofing.

6. Simulation of HTTP protocol – The client sends a HTTP request (the request is sent in the actual format with request line, header lines). The server gets the HTTP request and understands what method is to be done and responds in a HTTP response message. The response message can have a status line and header lines followed by the data.
   - Client Request line format **:** method/ request http version
   - Server reply format **:** http version status code followed by requested page contents

7. Simulation of FTP – understanding control and data channels. The client initiates a TCP connection to the server and sends the required FTP command to the server. For example, “get filename”. The server reads the command, initiates a new TCP connection with the client using a different port number. The server then sends the result of the command to the client and closes the connection.

8. Consider software that resides in a system that reads the available main memory and hard disk at periodical intervals and pass this information on to another system on demand. This process is placed in more than one system so that network resource can be monitored. Implement a monitoring program and list out the time, IP address, available Hard disk and Main memory available in each system in a tabular form.

9. Use the software like wireshark in a LAN to capture the packet and do a statistical analysis such as: the number of packets (bits) flowing in/out of a designated system, a pair wise packet flow among the given IP addresses.

10. Use the packet capturing tool and measure the traffic from each node in a application wise, and pair wise traffic application

11. Repeat exercise 10 for protocol wise traffic analysis

**TOTAL: 45 PERIODS**

**OUTCOMES:**
At the end of the course, the students will be able to

- Design network applications using TCP and UDP
- Demonstrate the usage of various networking tools.
- Analyze network traffic
- Analyze packets transmitted over the network.

**IF7113** **MINI PROJECT** **L T P C**
**0 0 2 1**

The objective of the mini project is to enable the students to apply the techniques they have learnt over the courses:

- The students can select any of the problem of their choice related to direct application
- A team can be formed with 2-3 members
- Should inculcate the software engineering methodologies
- At least two hours per week should be spent in doing this mini project
- The students should design and experiment using object oriented concept

- A database has to be designed and implemented
- The developed project must be web enabled
- The developed mini project must be tested for different cases of operations
- A documentation has to be prepared in the form of a report
- Evaluation pattern is like Lab examination

**TOTAL :30 PERIODS**

**IF7201** **WEB TECHNOLOGIES** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To understand the basics of web technology and design methods.
- To learn to design interactive web pages using Markup languages, CSS, Java Script.
- Understand the web platform for creating information sharing and functionality using PHP
- Learn to develop Enterprise Applications for Online communities in the Business World.
- To understand the representation of Web Data using XML technologies
- To understand the techniques of Server side programming

**UNIT I WEB TECHNONOGY AND DESIGN METHODS 9**

**Web Technology –** The concept of Tiers – Web Pages Types and Issues – Static, Dynamic, Active web Pages. Problems with Statelessness – Sessions and Sessions Management – Techniques for maintaining State Information.

**Web Design Methods** – Design Issues – OOWS Model_Driven approach – OOHDM – UML based Web Engineering.

**UNIT II WEB APPLICATION DEVELOPMENT 9**

Client Side Scripting: HTML5 – Elements – canvas – Video on the Web - Cascading Style Sheet 3– Client side scripting – JavaScript – Arrays - JavaScript Objects.
Server Side Scripting: PHP – Introduction – Creating PHP Pages – PHP with MySQL – Tables to display data – Form elements.

**UNIT III REPRESENTING WEB DATA 9**

XML Basics – XML Namespaces - XML Schema - DOM – SAX – XPath - XSL: Extensible Style sheet Language – Extensible Style sheet Language Transformations (XSLT).

**UNIT IV ENTERPRISE APPLICATION DEVELOPMENT 9**

Working With Model-View-Controller – Introduction to J2EE – JMS - Server Side Component Architecture – EJB overview –Types – Session Beans – Message driven Bean - Entity Beans – Persistent Entity Beans –Building business logic with session bean – messaging with message driven bean - Transactions and Security – Bean managed transaction –Exposing EJB as a web services – JAX-WS.

**UNIT V SERVER SIDE APPLICATIONS 9**

Overview of servlets – Servlet API – Servlet life cycle – Servlet configuration – Java Database Connectivity (JDBC) - Running Servlet with database connectivity - Servlet support for cookies – Session tracking- JSP – JSP with JDBC and applications

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon completion of the course, the students will be able to

- Create interactive web pages using Markup languages, CSS, Java Script.
- Implement server-Side Programming for creating information sharing and functionality using PHP.
- Work on XML Technologies
- Develop Enterprise Applications for online communities in the business world.

**REFERENCES:**


1. Gustavo Rossi, Oscar Pastor, Daniel Schwabe, Luis Olsina, “Web Engineering Modeling and Implementing web Applications”, Springer, 2008. (Unit -1)
2. Achyut S. Godbole, Atul Kahate, “Web Technologies – TCP/IP to Internet Application Architecture”, TMGH,2003.(Unit – 1).
3. Deitel & Deitel Internet & World Wide Web How to Program, Pearson Education India -Third Edition -2004 (Unit - 2).
4. Mark Pilgrim**, “**HTML5: Up and Running**” ,** O’Reilly,2010. (Unit - 2).
5. Michael K. Glass, Yann Le Scouarnec, Elizabeth Naramore, Gary Mailer,J.Stolz, J.Gerner, “Beginning PHP, Apache, MySQL, WebDevelopment”, Wrox, Wiley dreamtech India Ltd., 2004. (Unit - 2).
6. Deitel & Deitel, Neito, Lin, Sadhu, “XML How to Program”, Pearson Education,2008(Unit – 3).
7. Debu Panda, Reza Rahman, Derek Lane, “EJB 3 in Action”, Dreamtech Press, 2007. (Unit-4)
8. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, “Introduction to Information Retrieval”, Cambridge University Press, 2008 (Unit – 5)


**IF7202 CLOUD COMPUTING L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the broad perceptive of cloud architecture and model
- To understand the concept of Virtualization
- To be familiar with the lead players in cloud.
- To understand the features of cloud simulator
- To apply different cloud programming model as per need.
- To be able to set up a private cloud.
- To understand the design of cloud Services.
- To learn to design the trusted cloud Computing system

**UNIT I CLOUD ARCHITECTURE AND MODEL 9**

Technologies for Network-Based System – System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture.

Cloud Models:- Characteristics – Cloud Services – Cloud models (IaaS, PaaS, SaaS) – Public vs Private Cloud –Cloud Solutions - Cloud ecosystem – Service management – Computing on demand.

**UNIT II VIRTUALIZATION 9**

Basics of Virtualization - Types of Virtualization - Implementation Levels of Virtualization - Virtualization Structures - Tools and Mechanisms - Virtualization of CPU, Memory, I/O Devices - Virtual Clusters and Resource management – Virtualization for Data-center Automation.

**UNIT III CLOUD INFRASTRUCTURE 9**

Architectural Design of Compute and Storage Clouds – Layered Cloud Architecture Development – Design Challenges - Inter Cloud Resource Management – Resource Provisioning and Platform Deployment – Global Exchange of Cloud Resources.

**UNIT IV PROGRAMMING MODEL 9**

Parallel and Distributed Programming Paradigms – MapReduce , Twister and Iterative Map Reduce – Hadoop Library from Apache – Mapping Applications - Programming Support - Google App Engine, Amazon AWS - Cloud Software Environments -Eucalyptus, Open Nebula, OpenStack, Aneka, CloudSim

**UNIT V SECURITY IN THE CLOUD 9**

Security Overview – Cloud Security Challenges and Risks – Software-as-a-Service Security – Security Governance – Risk Management – Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security - Identity Management and Access Control – Autonomic Security.

**TOTAL:45 PERIODS**

**OUTCOMES:**

- Compare the strengths and limitations of cloud computing
- Identify the architecture, infrastructure and delivery models of cloud computing
- Apply suitable virtualization concept.
- Choose the appropriate cloud player
- Choose the appropriate Programming Models and approach.
- Address the core issues of cloud computing such as security, privacy and interoperability
- Design Cloud Services
- Set a private cloud

**REFERENCES:**


1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012.
2. John W.Rittinghouse and James F.Ransome, “Cloud Computing: Implementation, Management, and Security”, CRC Press, 2010.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing, A Practical Approach”, TMH, 2009.
4. Kumar Saurabh, “Cloud Computing – insights into New-Era Infrastructure”, Wiley India,2011.
5. George Reese, “Cloud Application Architectures: Building Applications and Infrastructure in the Cloud” O’Reilly
6. James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann, 2005.
7. Katarina Stanoevska-Slabeva, Thomas Wozniak, Santi Ristol, “Grid and Cloud Computing – A Business Perspective on Technology and Applications”, Springer.
8. Ronald L. Krutz, Russell Dean Vines, “Cloud Security – A comprehensive Guide to Secure Cloud Computing”, Wiley – India, 2010.

9. Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi, 'Mastering Cloud Computing", TMGH,2013.
10. Gautam Shroff,Enterprise Cloud Computing,Cambridge University Press,2011
11. Michael Miller, Cloud Computing,Que Publishing,2008
12. Nick Antonopoulos, Cloud computing,Springer Publications,2010

**NE7202 NETWORK AND INFORMATION SECURITY L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To understand the fundamentals of Cryptography
- To acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.
- To understand the various key distribution and management schemes.
- To understand how to deploy encryption techniques to secure data in transit across data networks
- To design security applications in the field of Information technology.

**UNIT I INTRODUCTION 9**

An Overview of Computer Security-Security Services-Security Mechanisms-Security Attacks-Access Control Matrix, Policy-Security policies, Confidentiality policies, Integrity policies and Hybrid policies.

**UNIT II CRYPTOSYSTEMS & AUTHENTICATION 9**

Classical Cryptography-Substitution Ciphers-permutation Ciphers-Block Ciphers-DES- Modes of Operation- AES-Linear Cryptanalysis, Differential Cryptanalysis- Hash Function - SHA 512-Message Authentication Codes-HMAC - Authentication Protocols

**UNIT III PUBLIC KEY CRYPTOSYSTEMS 9**

Introduction to Public key Cryptography- Number theory- The RSA Cryptosystem and Factoring Integer- Attacks on RSA-The ELGamal Cryptosystem- Digital Signature Algorithm-Finite Fields-Elliptic Curves Cryptography- Key management – Session and Interchange keys, Key exchange and generation-PKI

**UNIT IV SYSTEM IMPLEMENTATION 9**

Design Principles, Representing Identity, Access Control Mechanisms, Information Flow and Confinement Problem.

**Secure Software Development**: Secured Coding - OWASP/SANS Top Vulnerabilities - Buffer Overflows - Incomplete mediation - XSS - Anti Cross Site Scripting Libraries - Canonical Data Format - Command Injection - Redirection - Inference – Application Controls

**UNIT V NETWORK SECURITY 9**

Secret Sharing Schemes-Kerberos- Pretty Good Privacy (PGP)-Secure Socket Layer (SSL)-Intruders – HIDS- NIDS - Firewalls - Viruses

**TOTAL: 45 PERIODS.**

**OUTCOMES:**

Upon completion of the course, the students will be able to

- Implement basic security algorithms required by any computing system.
- Analyze the vulnerabilities in any computing system and hence be able to design a security solution.
- Analyze the possible security attacks in complex real time systems and their effective countermeasures

- Identify the security issues in the network and resolve it.
- Evaluate security mechanisms using rigorous approaches, including theoretical derivation, modeling, and simulations
- Formulate research problems in the computer security field.

**REFERENCES:**


1. William Stallings, “Cryptography and Network Security: Principles and Practices”, Third Edition, Pearson Education, 2006.
2. Matt Bishop ,“Computer Security art and science ”, Second Edition, Pearson Education, 2002
3. Wade Trappe and Lawrence C. Washington, “Introduction to Cryptography with Coding Theory” Second Edition, Pearson Education, 2007
4. Jonathan Katz, and Yehuda Lindell, Introduction to Modern Cryptography, CRC Press, 2007Douglas R. Stinson, “Cryptography Theory and Practice”, Third Edition, Chapman & Hall/CRC, 2006
5. Douglas R. Stinson, “Cryptography Theory and Practice”, Third Edition, Chapman & Hall/CRC, 2006
6. Wenbo Mao, “Modern Cryptography – Theory and Practice”, Pearson Education, First Edition, 2006.
7. Network Security and Cryptography, Menezes Bernard, Cengage Learning, New Delhi, 2011
8. Man Young Rhee, Internet Security, Wiley, 2003
9. OWASP top ten security vulnerabilities: http://xml.coverpages.org/OWASP-TopTen.pdf


**IF7203 DATA WAREHOUSING AND DATA MINING L T P C**
**3 0 0 3**

**OBJECTIVES :**

- To expose the students to the concepts of Data warehousing Architecture and Implementation
- To Understand Data mining principles and techniques and Introduce DM as a cutting edge business intelligence
- To learn to use association rule mining for handling large data
- To understand the concept of classification for the retrieval purposes
- To know the clustering techniques in details for better organization and retrieval of data
- To identify Business applications and Trends of Data mining

**UNIT I DATA WAREHOUSE 8**

Data Warehousing - Operational Database Systems vs. Data Warehouses - Multidimensional Data Model - Schemas for Multidimensional Databases – OLAP Operations – Data Warehouse Architecture – Indexing – OLAP queries & Tools.

**UNIT II DATA MINING & DATA PREPROCESSING 9**

Introduction to KDD process – Knowledge Discovery from Databases - Need for Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation.

**UNIT III ASSOCIATION RULE MINING 8**

Introduction - Data Mining Functionalities - Association Rule Mining - Mining Frequent Itemsets with and without Candidate Generation - Mining Various Kinds of Association Rules - Constraint-Based Association Mining.

**UNIT IV CLASSIFICATION & PREDICTION 10**

Classification vs. Prediction – Data preparation for 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 V CLUSTERING 10**

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.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon Completion of the course, the students will be able to

- Store voluminous data for online processing
- Preprocess the data for mining applications
- Apply the association rules for mining the data
- Design and deploy appropriate classification techniques
- Cluster the high dimensional data for better organization of the data
- Discover the knowledge imbibed in the high dimensional system
- Evolve Multidimensional Intelligent model from typical system
- Evaluate various mining techniques on complex data objects

**REFERENCES:**


1. Jiawei Han and Micheline Kamber, “Data Mining Concepts and Techniques” Second Edition, Elsevier, Reprinted 2008.
2. K.P. Soman, Shyam Diwakar and V. Ajay, “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.
3. G. K. Gupta, “Introduction to Data Mining with Case Studies”, Easter Economy Edition, Prentice Hall of India, 2006.
4. BERSON, ALEX & SMITH, STEPHEN J, Data Warehousing, Data Mining, and OLAP, TMH Pub. Co. Ltd, New Delhi, 2012
5. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, “Introduction to Data Mining”, Pearson Education, 2007
6. PRABHU Data Warehousing, PHI Learning Private Limited, New Delhi, 2012, ,
7. PONNIAH, PAULRAJ, Data Warehousing Fundamentals, John Wiley & Sons, New Delhi, 2011
8. MARAKAS, GEORGE M, Modern Data Warehousing, Mining, and Visualization, Pearson Education, 2011


**IF7211 WEB TECHNOLOGY LABORATORY L T P C**
**0 0 3 2**

**OBJECTIVES**

- To learn how to create a simple web page using html along with the usage of style sheets, lists, creation or tables with borders, padding and colors.
- To get acquainted with JavaScript and how to embed JavaScript in HTML code.
- To learn to construct dynamic server-side web pages and integrate the web application with many of the other Java2 Enterprise Edition application server methodologies
- To learn to develop Java Enterprise Applications using EJB3 and other Java EE technology

**EXPERIMENT**

1. Web programming with HTML tags, CSS for styling, Page layout
   a. Create a tourist web site using HTML and embed an in a world map in it. Using image map fix hot spots for each continent and show all the related information when the hot spots are clicked.
   b. Design a HTML form for a railway ticket reservation system with various form controls.
   c. Create a web site for Online Shopping application. The home page must be divided into three frames. The top frame must be 15% and should display the logo and the moto of the Shopping application along with some pictures. The remaining 85% portion must be divided into two frames. The left frame must be 25% and is meant for appropriate navigation links. The right frame must take the remaining width and must be the target for all the hosted links in the left frame.
   d. Apply CSS property to a table with alternate rows displayed in different colors.
   e. Design the style rule which can be applied for hyperlinks using pseudo class properties.
   f. Write a style rule that will place a nice frame around an image element. Choose suitable color, design and size for the border.
   g. Design the style rule which can be applied for an online shopping application. The shopping application displays the image for each item and the details of the item. When the mouse over event occurs on the image of an item, the magnified image must be displayed dynamically.

2. Develop webpage using HTML forms and JavaScript for client side programming
   a. Design a registration page which accepts name, address, pin code, phone no., and e-mail Id. Write suitable JavaScript functions to validate the form whether
      - all fields are entered
      - e-mail Id is a valid one (check for @ and . symbol)
      - phone no. is a valid one (only 10 digits)
      - pin code is having only 6 digits.

   b. Using a Reg Exp instance, write a JavaScript function is Valid( ) that accepts a String argument and returns true if the argument matches one of the following phone-number formats and returns false otherwise:
      - (123)456-7890
      - (123) 456-7890
      - 123/456-7890
      - 123-456-7890
      - 123 456 7890
      - 123456789

   c. Date has to be printed in several common formats. Write a JavaScript that accepts a date from an XHTML form and convert it to a Date object. Use various methods of the Date object that convert the given date into string and display it in several formats.

   d. Write a JavaScript to simulate the rolling of two dice. The script should use Math.random( ) to roll the first die and again to roll the second die. The sum of the two values should then be calculated. [Note: Since each die can show an integer value from 1 to 6, the sum of the values will vary from 2 to 12, with 7 being the most frequent sum, and 2 and 12 the least frequent sums. Your program should roll the dice 36,000 times. Use a one-dimensional array to tally the number of times each possible sum appears. Display the results in an XHTML table. Also determine whether the totals are reasonable (e.g., there are six ways to roll a 7, so approximately 1/6 of all the rolls should be 7).

3. Using The DOM and the JavaScript object models.
   a. Create a decorative cursor trail which follows the cursor movement in the window.
   b. Design a dynamic dropdown menu in a web page
   c. Write a program to detect which browser is used by the user to host a web page.

4. Website optimization: crunching HTML, using CSS to replace HTML and light-weight graphics to speed up websites.
   a. Use DHTML to obtain different transition with different filters.
   b. Use sequencer control to create a slideshow of images.
   c. Use path control to have the logo of a webpage follow an Oval path around the page.

5. Creating XML document with XML DTD and XML schema, SAX, XSL
   a. Create an XML file for storing the book details in a library and write DTD for the same to validate the XML document.
   b. Create an XML file for storing the employee details in an organization and write XML Schema for the same.
   c. Write a program using SAX to count the number of employees in the organization from the above XML data.
   d. Write a program using SAX to list out the employees who are in the Manager designation.
   e. Write an XSL to display the XML document for book details and Employees in a HTML table.

6. Web site creation with PHP for server side programming for storing current date-time using cookies and for storing page views using sessions.

7. Web application development using PHP
   a. Write a test application to check an e-mail address. Verify that the input begins with series of characters, followed by @ character, another series of characters, a period (.) and a final series of characters.
   b. Write a program that logs the address information from the web server, using environment variables.

8. Working with PHP and MySQL for a ticket reservation system: Develop a client form to get the passenger queries such as timings, availability, fare and get it from the backend MySQL server

9. Construct dynamic server-side web pages using JSF and integrate the Web application with Enterprise Java Beans, and SOAP.

10. Developing Java Enterprise Applications Using EJB3 Session beans, entity beans and message-driven beans for a simple inventory application.

11. Develop routines with JMS to receive message from different sources and store in the database using JDBC connectivity

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Develop Web application using HTML and scripting technologies.
- Work on Web application development using advanced features.
- Design and development of dynamic server-side web pages.
- Develop web services using J2EE and related technologies
- Design and development applications using JMS and JDBC

**IF7212** **CLOUD COMPUTING LABORATORY** **LT P C**
**0 0 3 2**

**OBJECTIVES**

- To learn how to use Cloud Services.
- To implement Virtualization
- To implement Task Scheduling algorithms.
- Apply Map-Reduce concept to applications.
- To build Private Cloud.

**EXPERIMENT**

12. Create a Collaborative learning environment for a particular learning topic using Google Apps. Google Drive, Google Docs and Google Slides must be used for hosting e-books, important articles and presentations respectively. The instructor must use the Google Sheets to convey the timetable for different events and for analyzing the scores for individual assignment submission.
13. Modeling and simulation Cloud computing environments, including Data Centers, Hosts and Cloudlets and perform VM provisioning using CloudSim: Design a host with two CPU cores, which receives request for hosting two VMs, such that each one requires two cores and plans to host four tasks units. More specifically, tasks t1, t2, t3 and t4 to be hosted in VM1, while t5, t6, t7, and t8 to be hosted in VM2.

    Implement space-shared allocation policy and time-shared allocation policy. Compare the results.

14. Model a Cloud computing environment having Data center that had 100 hosts. The hosts are to be modeled to have a CPU core (1000 MIPS), 2 GB of RAM and 1 TB of storage. Consider the workload model for this evaluation included provisioning requests for 400 VMs, with each request demanding 1 CPU core (250 MIPS), 256 MB of RAM and 1 GB of storage. Each VM hosts a *web-hosting application service*, whose CPU utilization distribution was generated according to the uniform distribution. Each instance of a web-hosting service required 150,000 MIPS or about 10 minutes to complete execution assuming 100% utilization.

    Simulate Energy-conscious model for power consumption and power management techniques such as Dynamic Voltage and Frequency Scaling (DVFS).

    Initially, VMs are to be allocated according to requested parameters (4 VMs on each host). The Cloud computing architecture that is to be considered for studying energy-conscious resource management techniques/policies included a data center, CloudCoordinator, and Sensor component. The CloudCoordinator and Sensor perform their usual roles. Via the attached Sensors (which are connected with every host), CloudCoordinator must periodically monitor the performance status of active VMs such as load conditions, and processing share. This real time information is to be passed to VMM, which can use it for performing appropriate resizing of VMs and application of DVFS and soft scaling. CloudCoordinator continuously has to adapt allocation of VMs by issuing VM migration commands and changing power states of nodes according to its policy and current utilization of resources.

15. Model and simulate the environment consisting of a data center with 10,000 hosts where each host was modeled to have a single CPU core (1200MIPS), 4GB of RAM memory and 2TB of storage. Consider the provisioning policy for VMs as space-shared, which allows one VM to be active in a host at a given instance of time. Make a request from the end-user (through the DatacenterBroker) for creation and instantiation of 50 VMs that had following constraints: 1024MB of physical memory, 1 CPU core and 1GB of storage. The application granularity was modeled to be composed of 300 task units, with each task unit requiring 1,440,000 million instructions (20 minutes in the simulated hosts) to be executed on a host. Minimal data transfer (300 KB) overhead can be considered for the task units (to and from the data center). After the creation of VMs, task units were submitted in small groups of 50 (one for each VM) at inter-arrival delay of 10 minutes.

16. Implement Map Reduce concept for
    a. Strassen's Matrix Multiplication for a huge matrix.
    b. Computing the average number of citation index a researcher has according to age among some 1 billion journal articles.
17. Consider a network of entities and relationships between them. It is required to calculate a state of each entity on the basis of properties of the other entities in its neighborhood. This state can represent a distance to other nodes, indication that there is a neighbor with the certain properties, characteristic of neighborhood density and so on. A network is stored as a set of nodes and each node contains a list of adjacent node IDs. Mapper emits messages for

each node using ID of the adjacent node as a key. Reducer must recompute state and rewrite node with the new state. Implement this scenario.

18. Setup a Private Cloud Using OpenStack or Eucalyptus. Develop a simple applications and make it available to the intended user
19. Install and configure OpenStack Object Storage - Swift in Ubuntu. Consider a huge storage requirements and store it in the cloud in a transparent manner
20. Install and configure OpenStack Nova-Compute. Enable a connected user to get a virtual machine of a selected performance such as CPU, Memory
21. Install and configure Stack Image services to query for information on available disk images, and use the Image Service's client library for streaming virtual disk images.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Demonstrate and experiment simple Cloud Applications
- Apply resource allocation, scheduling algorithms.
- Implement Map-Reduce concept.
- Create virtual machines from available physical resources.
- Setup a private cloud.
- Familiarize with Open Stack.

| IF7213 | TECHNICAL SEMINAR | L T P C |
|---|---|---|
| | | 0 0 2 1 |

The objective of this technical seminar is to enable the students to read technical article, comprehend and to share with others

The students should read a recent technical article from any of the leading reputed journals like:

- IEEE Transactions
- ACM
- Springer
- Elsevier publications

In the area of

- Web Technology
- Cloud Computing
- Security
- Data mining

and present to the fellow students with a technical report. External assessment should be conducted along with web technology lab.

**TOTAL:30 PERIODS**

**IF7301** **SOFT COMPUTING** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To learn the key aspects of Soft computing
- To know about the components and building block hypothesis of Genetic algorithm.
- To understand the features of neural network and its applications
- To study the fuzzy logic components
- To gain insight onto Neuro Fuzzy modeling and control.
- To gain knowledge in machine learning through Support vector machines.

**UNIT I INTRODUCTION TO SOFT COMPUTING 9**

Evolution of Computing - Soft Computing Constituents – From Conventional AI to Computational Intelligence - Machine Learning Basics

**UNIT II GENETIC ALGORITHMS 9**

Introduction, Building block hypothesis, working principle, Basic operators and Terminologies like individual, gene, encoding, fitness function and reproduction, Genetic modeling: Significance of Genetic operators, Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator, GA optimization problems, JSPP (Job Shop Scheduling Problem), TSP (Travelling Salesman Problem),Differences & similarities between GA & other traditional methods, Applications of GA.

**UNIT III NEURAL NETWORKS 9**

Machine Learning using Neural Network, Adaptive Networks – Feed Forward Networks – Supervised Learning Neural Networks – Radial Basis Function Networks - Reinforcement Learning – Unsupervised Learning Neural Networks – Adaptive Resonance Architectures – Advances in Neural Networks.

**UNIT IV FUZZY LOGIC 9**

Fuzzy Sets – Operations on Fuzzy Sets – Fuzzy Relations – Membership Functions-Fuzzy Rules and Fuzzy Reasoning – Fuzzy Inference Systems – Fuzzy Expert Systems – Fuzzy Decision Making

**UNIT V NEURO-FUZZY MODELING 9**

Adaptive Neuro-Fuzzy Inference Systems – Coactive Neuro-Fuzzy Modeling – Classification and Regression Trees – Data Clustering Algorithms – Rule base Structure Identification – Neuro-Fuzzy Control – Case Studies.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Implement machine learning through neural networks.
- Write Genetic Algorithm to solve the optimization problem
- Develop a Fuzzy expert system.
- Model Neuro Fuzzy system for clustering and classification.

**REFERENCES:**


1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, “Neuro-Fuzzy and Soft Computing”, Prentice-Hall of India, 2003
2. Kwang H.Lee, “First course on Fuzzy Theory and Applications”, Springer–Verlag Berlin Heidelberg, 2005.
3. George J. Klir and Bo Yuan, “Fuzzy Sets and Fuzzy Logic-Theory and Applications”, Prentice Hall, 1995.
4. James A. Freeman and David M. Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Pearson Edn., 2003.

5. David E. Goldberg, “Genetic Algorithms in Search, Optimization and Machine Learning”, Addison Wesley, 2007.
6. Mitsuo Gen and Runwei Cheng,”Genetic Algorithms and Engineering Optimization”, Wiley Publishers 2000.
7. Mitchell Melanie, “An Introduction to Genetic Algorithm”, Prentice Hall, 1998.
8. S.N.Sivanandam, S.N.Deepa, “Introduction to Genetic Algorithms”, Springer, 2007.
9. A.E. Eiben and J.E. Smith “Introduction to Evolutionary Computing” Springer, 2003
10. E. Sanchez, T. Shibata, and L. A. Zadeh, Eds., "Genetic Algorithms and Fuzzy Logic Systems: Soft Computing Perspectives, Advances in Fuzzy Systems - Applications and Theory", Vol. 7, River Edge, World Scientific, 1997.
11. ROSS TIMOTHY J, Fuzzy Logic with Engineering Applications, Wiley India Pvt Ltd, New Delhi, 2010

**IF7001 SOFTWARE METRICS AND RELIABILITY L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To gain basic knowledge about metrics, measurement theory and related terminologies
- To measure the quality level of internal and external attributes of the software product
- To introduce the basics of software reliability and to illustrate how to perform planning, executing and testing for software reliability
- To explore various metrics and models of software reliability
- To compare various models of software reliability based on its application

**UNIT I FUNDAMENTALS OF MEASUREMENTS 9**

Measurements in Software Engineering – Scope of Software Metrics – Fundamentals of Measurements Theory – Goal Based Framework – Software Measurement Validation.

**UNIT II METRICS AND MODELS 9**

Measurement of Internal Product Attributes – Size and Structure – External Product Attributes - Measurement of Quality– Reliability Model – Exponential Distribution and Reliability Growth Model – Availability Metrics.

**UNIT III INTRODUCTION TO SOFTWARE RELIABILITY 9**

Basic Concepts – Failure and Faults – Environment – Availability –Modeling –uses.

**UNIT IV SOFTWARE RELIABILITY MODELING 9**

Concepts – General Model Characteristic – Historical Development of models – Model Classification scheme – Markovian models – General concepts – General Poisson Type Models – Binomial Type Models – Poisson Type models – Fault reduction factor for Poisson Type models.

**UNIT V COMPARISON OF SOFTWARE RELIABILITY MODELS 9**

Comparison Criteria – Failure Data – Comparison of Predictive Validity of Model Groups – Recommended Models – Comparison of Time Domains – Calendar Time Modeling – Limiting Resource Concept – Resource Usage model – Resource Utilization – Calendar Time Estimation and confidence Intervals.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon Completion of the course, the students should be able to:

- Identify and apply various software metrics, which determines the quality level of software
- Identify and evaluate the quality level of internal and external attributes of the software product
- Compare and Pick out the right reliability model for evaluating the software
- Evaluate the reliability of any given software product
- Design new metrics and reliability models for evaluating the quality level of the software based on the requirement

**REFERENCES:**


1. John D. Musa, “Software Reliability Engineering”, Tata McGraw Hill, 2004.
2. Norman E . Fenton, Shari Lawrence Pfleeger, "Software metrics", Second Edition, International Student Edition, 2003.
3. John D. Musa, Anthony Iannino, Kazuhira Okumoto, “Software Reliability – Measurement, Prediction, Application, Series in Software Engineering and Technology”, McGraw Hill, 1987.
4. Stephen H. Kan, “Metrics and Models in Software Quality Engineering”, Second Edition, Addison-Wesley Professional,2002
5. N.Fenton and B.Little Wood, Software Reliability and Metrics, Springer, 1991
6. Michael R.Lyu, Handbook of Software Reliability Engineering, McGraw-Hill, 1996
7. Steven R.Rakitin, Software Verification and Validation for Practitioners and Managers, Artech House, Inc. Norwood, MA, USA, 2001


**NE7007 NETWORK MANAGEMENT L T P C**

**3 0 0 3**

**OBJECTIVES**

The objective of this course is to

- To understand the need for interoperable network management
- To learn to the concepts and architecture behind standards based network management
- To understand the concepts and terminology associated with SNMP and TMN
- To understand network management as a typical distributed application
- To study the current trends in network management technologies

**UNIT I FUNDAMENTALS OF COMPUTER NETWORK TECHNOLOGY 9**

Network Topology, LAN, Network node components- Hubs, Bridges, Routers, Gateways, Switches, WAN, ISDN Transmission Technology, Communications protocols and standards. Network Management: Goals, Organization, and Functions, Network and System Management, Network Management System Platform, Current Status and future of Network

**UNIT II OSI NETWORK MANAGEMENT 9**

OSI Network management model-Organizational model-Information model, communication model. Abstract Syntax Notation - Encoding structure, Macros Functional model CMIP/CMIS

**UNIT III INTERNET MANAGEMENT(SNMP) 9**

SNMP(V1 and V2)-Organizational model-System Overview, The information model, communication model-Functional model, SNMP proxy server, Management information, protocol remote monitoring- , RMON SMI and MIB, RMON1,RMON2 - A Case Study of Internet Traffic Using RMON.

**UNIT IV BROADBAND NETWORK MANAGEMENT 9**

Broadband networks and services, ATM Technology-VP,VC, ATM Packet, Integrated service, ATMLAN emulation, Virtual Lan. ATM Network Management-ATM Network reference model, integrated local management Interface. ATM Management Information base, Role of SNMD and ILMI in ATM Management, M1, M2, M3, M4 Interface. ATM Digital Exchange Interface Management- , TMN conceptual Model- TMN Architecture, TMN Management Service Architecture

**UNIT V NETWORK MANAGEMENT APPLICATIONS 9**

Configuration management, Fault management, performance management, Event Correlation Techniques security Management, Accounting management, Report Management, Policy Based Management Service Level Management- Network Management Tools, Network Statistics Measurement Systems – Web Based Management, XML Based Network Management - : Future Directions.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon completion of this course, the students will be able to

- Analyze the issues and challenges pertaining to management of emerging network technologies such as wired/wireless networks and high-speed internets.
- Apply network management standards to manage practical networks.
- Formulate possible approaches for managing OSI network model.
- Use on SNMP for managing the network
- Use RMON for monitoring the behavior of the network
- Explore the possibilities of improving the speed of the network and managing them
- Identify the various components of network and formulate the scheme for the managing them

**REFERENCES:**


1. Mani Subramanian, “Network Management Principles and practice ", Pearson Education, New Delhi, 2010.
2. STALLINGS, WILLIAM, “SNMP, SNMPv2, SNMPv3, and RMON 1 and 2,” Pearson Education, 2012
3. Salah Aiidarous, Thomas Plevayk, “Telecommunications Network Management Technologies and Implementations ", eastern Economy Edition IEEE press, New Delhi, 1998.
4. Lakshmi G. Raman, “Fundamentals of Telecommunication Network Management ", Eastern Economy Edition IEEE Press, New Delhi, 1999.


**IF7002 BIOINFORMATICS L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To get exposed to the domain of bioinformatics
- To understand the role of data warehousing and data mining for bioinformatics
- To learn to model bioinformatics based applications
- To understand how to deploy the pattern matching and visualization techniques in bioinformatics
- To study the Microarray technologies for genome expression

**UNIT I INTRODUCTION 9**

Need for Bioinformatics technologies – Overview of Bioinformatics technologies – Structural bioinformatics – Data format and processing – secondary resources- Applications – Role of Structural bioinformatics - Biological Data Integration System.

**UNIT II DATAWAREHOUSING AND DATAMINING IN BIOINFORMATICS 9**

Bioinformatics data – Data ware housing architecture – data quality – Biomedical data analysis – DNA data analysis – Protein data analysis – Machine learning – Neural network architecture- Applications in bioinformatics

**UNIT III MODELING FOR BIOINFORMATICS 9**

Hidden markov modeling for biological data analysis – Sequence identification – Sequence classification – multiple alignment generation – Comparative modeling – Protein modeling – genomic modeling – Probabilistic modeling – Bayesian networks – Boolean networks - Molecular modeling – Computer programs for molecular modeling

**UNIT IV PATTERN MATCHING AND VISUALIZATION 9**

Gene regulation – motif recognition and motif detection – strategies for motif detection – Visualization – Fractal analysis – DNA walk models – one dimension – two dimension – higher dimension – Game representation of Biological sequences – DNA, Protein, Amino acid sequences

**UNIT V MICROARRAY ANALYSIS 9**

Microarray technology for genome expression study – image analysis for data extraction – preprocessing – segmentation – gridding , spot extraction , normalization, filtering – cluster analysis – gene network analysis – Compared Evaluation of Scientific Data Management Systems – Cost Matrix – Evaluation model ,Benchmark , Tradeoffs

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon Completion of the course, the students will be able to

- Deploy the data warehousing and data mining techniques in Bioinformatics
- Model bioinformatics based applications
- Deploy the pattern matching and visualization techniques in bioinformatics
- Work on the protein sequences
- Use the Microarray technologies for genome expression

**REFERENCES:**


1. Yi-Ping Phoebe Chen (Ed), “Bio Informatics Technologies”, First Indian Reprint, Springer Verlag, 2007.
2. N.J. Chikhale and Virendra Gomase, "Bioinformatics- Theory and Practice", Himalaya Publication House, India, 2007
3. Zoe lacroix and Terence Critchlow, “Bio Informatics – Managing Scientific data”, First Indian Reprint, Elsevier, 2004
4. Bryan Bergeron, “Bio Informatics Computing”, Second Edition, Pearson Education, 2003.
5. Arthur M Lesk, “Introduction to Bioinformatics”, Second Edition, Oxford University Press, 2005
6. Burton. E. Tropp, “Molecular Biology: Genes to Proteins “, 4th edition, Jones and Bartlett Publishers, 2011
7. Dan Gusfield, “Algorithms on Strings Trees and Sequences”, Cambridge University Press, 1997.
8. P. Baldi, S Brunak , Bioinformatics, “A Machine Learning Approach “, MIT Press, 1998.

**MP7001** **XML AND WEBSERVICES** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

To provide an in-depth knowledge of XML and Web Services.

- To understand the fundamental concepts of Web services.
- To Understand the fundamental concepts of XML Technology.
- To design Web service Architecture.
- To Study Building Blocks of Web services.
- To understand the XML security issues.

**UNIT I WEB FUNDAMENTALS** **9**

History of Web – Protocols – Web Applications - Web servers-Web Browsers-HTTP-Java Network Programming-HTML-CCS.

**UNIT II XML TECHNOLOGY** **9**

XML-XML DTD-W3C XML Schema-Parsing XML - X path- XML Transformation-Other XML Technologies..

**UNIT III ARCHITECTING WEB SERVICES** **9**

Business motivations for web services – B2B – B2C- Technical motivations — Service oriented Architecture (SOA) – Architecting web services – Implementation view – web services technology stack – logical view – composition of web services – deployment view – from application server to peer to peer – process view – life in the runtime

**UNIT IV WEB SERVICES BUILDING BLOCK** **9**

Transport protocols for web services – messaging with web services – protocols – SOAP – describing web services – WSDL – Anatomy of WSDL – manipulating WSDL – web service policy – Discovering web services – UDDI – Anatomy of UDDI

**UNIT V XML SECURITY** **9**

Security Overview - Canonicalization - XML Security Framework - XML Encryption - XML Digital Signature - XKMS Structure - Guidelines for Signing XML Documents - XML in Practice.

**TOTAL:45 PERIODS**

**OUTCOMES:**

Upon Completion of the course, the students will be able

- To Know the fundamental elements in Web Technology and XML services.
- To design the Architecture of Web Services.
- To construct building blocks of Web services.
- To analyze security in XML.

**REFERENCES:**


1. Uttam K.Roy , “Web Technologies”, Oxford University Press,2010
2. Ron schmelzer et al, “XML and Web Services”, Pearson Education, 2002.
3. Sandeep Chatterjee and James Webber, “Developing Enterprise Web Services: An Architect’s Guide”, Prentice Hall, 2004.
4. Frank. P. Coyle, XML, Web Services And The Data Revolution, Pearson Education, 2002
5. Keith Ballinger, “.NET Web Services Architecture and Implementation”, Pearson Education,2003
6. Henry Bequet and Meeraj Kunnumpurath, “Beginning Java Web Services”, Apress, 2004.
7. Russ Basiura and Mike Batongbacal, “Professional ASP.NET Web Services”, Apress2,2001.

**CP7028 ENTERPRISE APPLICATION INTEGRATION L T P C**
**3 0 0 3**

**OBJECTIVES:**

- Describe approaches to enterprise application integration
- Understand the integration middleware
- Evaluate the integration approaches suitable for a given problem

**UNIT I INTRODUCTION 6**

Requirements for EAI - Challenges in EAI – Integration with legacy systems – Integration with partners - Heterogeneous environment – Implementation approaches – Web services, messaging, ETL, direct data integration – Middleware requirements – Approaches to integration – services oriented and messaging.

**UNIT II INTEGRATION PATTERNS 6**

Introduction to integration patterns – Architecture for application integration – Integration patterns – Point to point, broker, message bus, publish/subscribe, Challenges in performance, security, reliability - Case studies

**UNIT III SERVICE ORIENTED INTEGRATION 12**

Business process integration - Composite applications-services – Web services – Service choreography and orchestration - Business process modeling - BPMN, Business process execution - BPEL – Middleware infrastructure - Case studies

**UNIT IV MESSAGING BASED INTEGRATION 9**

Messaging – Synchronous and asynchronous – Message structure – Message oriented middleware – Reliability mechanisms – Challenges – Messaging infrastructure – Java Messaging Services – Case studies

**UNIT V ENTERPRISE SERVICE BUS 12**

Enterprise Service Bus – routing, scalable connectivity, protocol and message transformations, data enrichment, distribution, correlation, monitoring – Deployment configurations – Global ESB, Directly connected, Federated, brokered ESBs – Application server based – Messaging system based – Hardware based ESBs – Support to SOA, message based and event based integrations - Case studies.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon Completion of the course,the students will be able to

- Describe different approaches to integration enterprise applications
- Analyze specifications and identify appropriate integration approaches
- Develop a suitable integration design for a given problem
- Identify appropriate integration middleware for a given problem
- Evaluate the integration approaches against specified requirements

**REFERENCES:**


1. George Mentzas and Andreas Frezen (Eds), "Semantic Enterprise Application Integration for Business Processes: Service-oriented Frameworks", Business Science Reference, 2009
2. Waseem Roshen, "SOA Based Enterprise Integration", Tata McGrawHill, 2009.
3. GHohpe and B Woolf, "Enterprise Integration Patterns: Designing, Building, and Deploying Messaging Solutions",Addison Wesley Professional, 2003
4. D Linthicum, "Next Generation Application Integration: From Simple Information to Web Services",Addison Wesley, 2003
5. Martin Fowler, "Patterns of Enterprise Application Architecture", Addison- Wesley, 2003
6. Kapil Pant and Matiaz Juric, "Business Process Driven SOA using BPMN and BPEL: From Business Process Modeling to Orchestration and Service Oriented Architecture", Packt Publishing, 2008

**IF7003** **VIDEO ANALYTICS** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To know the fundamental concepts of big data and analytics
- To learn various techniques for mining data streams
- To acquire the knowledge of extracting information from surveillance videos.
- To learn Event Modelling for different applications.
- To understand the models used for recognition of objects in videos.

**UNIT I INTRODUCTION TO BIG DATA & DATA ANALYSIS 9**

Introduction to Big Data Platform – Challenges of Conventional systems – Web data- Evolution of Analytic scalability- analytic processes and tools- Analysis Vs Reporting- Modern data analytic tools- Data Analysis: Regression Modeling- Bayesian Modeling- Rule induction.

**UNIT II MINING DATA STREAMS 9**

Introduction to Stream concepts- Stream data model and architecture – Stream Computing- Sampling data in a Stream- Filtering Streams- Counting distinct elements in a Stream- Estimating moments- Counting oneness in a window- Decaying window- Real time Analytics platform(RTAP) applications- case studies.

**UNIT III VIDEO ANALYTICS 9**

Introduction- Video Basics - Fundamentals for Video Surveillance- Scene Artifacts- **Object Detection and Tracking**: Adaptive Background Modelling and Subtraction- Pedestrian Detection and Tracking-Vehicle Detection and Tracking- Articulated Human Motion Tracking in Low-Dimensional Latent Spaces

**UNIT IV BEHAVIOURAL ANALYSIS & ACTIVITY RECOGNITION 9**

Event Modelling- Behavioural Analysis- Human Activity Recognition-Complex Activity Recognition- Activity modelling using 3D shape, Video summarization, shape based activity models- Suspicious Activity Detection

**UNIT V HUMAN FACE RECOGNITION & GAIT ANALYSIS 9**

Introduction: Overview of Recognition algorithms – Human Recognition using Face: Face Recognition from still images, Face Recognition from video, Evaluation of Face Recognition Technologies- Human Recognition using gait: HMM Framework for Gait Recognition, View Invariant Gait Recognition, Role of Shape and Dynamics in Gait Recognition

**TOTAL: 45 PERIODS**

**OUTCOMES:**

On successful completion of this course, students will be able to:

1. Work with big data platform and its analysis techniques.
2. Design efficient algorithms for mining the data from large volumes.
3. Work with surveillance videos for analytics.
4. Design of optimization algorithms for better analysis and recognition of objects in a scene.
5. Model a framework for Human Activity Recognition

**REFERENCES:**


1. Michael Berthold, David J.Hand, Intelligent Data Analysis, Springer, 2007.
2. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.
3. Yunqian Ma, Gang Qian, “Intelligent Video Surveillance: Systems and Technology”, CRC Press (Taylor and Francis Group), 2009.
4. Rama Chellappa, Amit K.Roy-Chowdhury, Kevin Zhou.S, “Recognition of Humans and their Activities using Video”, Morgan&Claypool Publishers, 2005.

**IF7004 SOFTWARE PROJECT MANAGEMENT L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To define and highlight importance of software project management.
- To formulate strategy in managing projects
- To estimate the cost associated with a project
- To plan, schedule and monitor projects for the risk management
- To define the software management metrics
- To train software project managers and other individuals involved in software project planning and tracking and oversight in the implementation of the software project management process

**UNIT I PROJECT MANAGEMENT CONCEPTS 9**

Evolution of Software Economics – Software Management Process Framework (Phases, Artifacts, Workflows, Checkpoints) – Software Management Disciplines (Planning / Project Organization and Responsibilities / Automation / Project Control) – Modern Project Profiles

**UNIT II SOFTWARE ESTIMATION & COSTING 9**

Problems in Software Estimation – Algorithmic Cost Estimation Process, Function Points, SLIM (Software Life cycle Management), COCOMO II (Constructive Cost Model) – Estimating Web Application Development – Concepts of Finance, Activity Based Costing and Economic Value Added (EVA) – Balanced Score Card.

**UNIT III RISK MANAGEMENT 9**

Risk Definition – Risk Categories – Risk Assessment (Identification / Analysis / Prioritization) – Risk Control (Planning / Resolution / Monitoring) – Failure Mode and Effects Analysis (FMEA)

**UNIT IV METRICS 9**

Need for Software Metrics – Classification of Software Metrics: Product Metrics (Size Metrics, Complexity Metrics, Halstead's Product Metrics, Quality Metrics), and Process metrics (Empirical Models, Statistical Models, Theory-based Models, Composite Models and Reliability Models).

**UNIT V MANAGING PEOPLE AND ORGANIZING TEAMS 9**

Introduction – Understanding Behavior – Organizational Behavior: A Background – Selecting the right person for the job – Instruction in the best methods – Motivation – The Oldman – Hackman Job Characteristics Model – Working in Groups – Becoming a team –Decision Making – Leadership – Organizational Structures – Stress –Health and Safety – Case Studies.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

At the end of this course students will be able to:

- Evaluate a project to develop the scope of work, provide accurate cost estimates and to plan the various activities
- Apply risk management analysis techniques that identify the factors that put a project at risk and to quantify the likely effect of risk on project timescales
- Identify the resources required for a project and to produce a work plan and resource schedule
- Monitor the progress of a project and to assess the risk of slippage, revising targets counteract drift
- Use appropriate metrics to management the software development outcome
- Engage and motivate the stakeholders of the project
- Develop research methods and techniques appropriate to defining, planning and carrying out a research project within your chosen specialist area within the management of software projects.

**REFERENCES:**


1. McConnell, S. “Software Project: Survival Guide”, Microsoft Press, 1998.
2. Bob Hughes, Mikecotterell, “Software Project Management”, Third Edition, Tata McGraw Hill, 2004.
3. Ramesh, Gopalaswamy, "Managing Global Projects", Tata McGraw Hill, 2001.
4. Royce, W. “Software Project management: A Unified Framework”, Addison-Wesley, 1998.
5. Cooper, R., “The Rise of Activity-Based Costing- Part One: What is an Activity-Based Cost System?” Journal of Cost Management, Vol.2, No.2 (Summer 1988), pp.45 –54
6. Grant, J.L. “Foundations of Economic Value Added”, John Wiley & Sons, 1997.Kaplan, R.S., Norton, D.P. “The Balanced Scorecard: Translating Strategy into Action”, Harvard Business School Press, 1996.
7. Boehm, B. W. "Software Risk Management: Principles and Practices" in IEEE Software, January 1991, pp32-41.
8. Fenton, N.E., and Pfleeger, S.L. “Software Metrics: A Rigorous and Practical Approach, Revised” Brooks Cole, 1998.
9. Demarco, T. and Lister, T. “Peopleware: Productive Projects and Teams, 2nd Ed.”, Dorset House, 1999.
10. Jalote, “Software Project Management in Practice”, Pearson Education, 2002.


**NE7002 MOBILE AND PERVASIVE COMPUTING L T P C**
**3 0 0 3**

**OBJECTIVES :**

- To understand the basics of Mobile Computing and Personal Computing
- To learn the role of cellular networks in Mobile and Pervasive Computing
- To expose to the concept of sensor and mesh networks
- To expose to the context aware and wearable computing
- To learn to develop applications in mobile and pervasive computing environment

**UNIT I INTRODUCTION 9**

Differences between Mobile Communication and Mobile Computing – Contexts and Names – Functions – Applications and Services – New Applications – Making Legacy Applications Mobile Enabled – Design Considerations – Integration of Wireless and Wired Networks – Standards Bodies – Pervasive Computing – Basics and Vision – Principles of Pervasive Computing – Categories of Pervasive Devices

**UNIT II 3G AND 4G CELLULAR NETWORKS 9**

Migration to 3G Networks – IMT 2000 and UMTS – UMTS Architecture – User Equipment – Radio Network Subsystem – UTRAN – Node B – RNC functions – USIM – Protocol Stack – CS and PS Domains – IMS Architecture – Handover – 3.5G and 3.9G a brief discussion – 4G LAN and Cellular Networks – LTE – Control Plane – NAS and RRC – User Plane – PDCP, RLC and MAC – WiMax IEEE 802.16d/e – WiMax Internetworking with 3GPP

**UNIT III SENSOR AND MESH NETWORKS 9**

Sensor Networks – Role in Pervasive Computing – In Network Processing and Data Dissemination – Sensor Databases – Data Management in Wireless Mobile Environments – Wireless Mesh Networks – Architecture – Mesh Routers – Mesh Clients – Routing – Cross Layer Approach – Security Aspects of Various Layers in WMN – Applications of Sensor and Mesh networks

**UNIT IV CONTEXT AWARE COMPUTING & WEARABLE COMPUTING 9**

Adaptability – Mechanisms for Adaptation - Functionality and Data – Transcoding – Location Aware Computing – Location Representation – Localization Techniques – Triangulation and Scene Analysis – Delaunay Triangulation and Voronoi graphs – Types of Context – Role of Mobile Middleware – Adaptation and Agents – Service Discovery Middleware

Health BAN- Medical and Technological Requirements-Wearable Sensors-Intra-BAN communications

**UNIT V APPLICATION DEVELOPMENT 9**

Three tier architecture - Model View Controller Architecture - Memory Management – Information Access Devices – PDAs and Smart Phones – Smart Cards and Embedded Controls – J2ME – Programming for CLDC – GUI in MIDP – Application Development ON Android and iPhone

**TOTAL: 45 PERIODS**

**OUTCOMES:**

At the end of the course the student should be able to

- Design a basic architecture for a pervasive computing environment
- Design and allocate the resources on the 3G-4G wireless networks
- Analyze the role of sensors in Wireless networks
- Work out the routing in mesh network
- Deploy the location and context information for application development
- Develop mobile computing applications based on the paradigm of context aware computing and wearable computing

**REFERENCES:**


1. Asoke K Talukder, Hasan Ahmed, Roopa R Yavagal, “Mobile Computing: Technology, Applications and Service Creation”, 2nd ed, Tata McGraw Hill, 2010.
2. Reto Meier, “Professional Android 2 Application Development”, Wrox Wiley,2010.
3. .Pei Zheng and Lionel M Li, ‘Smart Phone & Next Generation Mobile Computing’, Morgan Kaufmann Publishers, 2006.
4. Frank Adelstein, ‘Fundamentals of Mobile and Pervasive Computing’, TMH, 2005
5. Jochen Burthardt et al, ‘Pervasive Computing: Technology and Architecture of Mobile Internet Applications’, Pearson Education, 2003
6. Feng Zhao and Leonidas Guibas, ‘Wireless Sensor Networks’, Morgan Kaufmann Publishers, 2004
7. Uwe Hansmaan et al, ‘Principles of Mobile Computing’, Springer, 2003
8. Reto Meier, “Professional Android 2 Application Development”, Wrox Wiley,2010.
9. Mohammad s. Obaidat et al, “Pervasive Computing and Networking”,John wiley
10. Stefan Poslad, “Ubiquitous Computing: Smart Devices, Environments and Interactions”, Wiley, 2009
11. Frank Adelstein Sandeep K. S. Gupta Golden G. Richard III Loren Schwiebert “Fundamentals of Mobile and Pervasive Computing, “, McGraw-Hill, 2005


**CP7203 PRINCIPLES OF PROGRAMMING LANGUAGES L T P C**
**3 0 0 3**

**OBJECTIVES:**

1. To understand and describe syntax and semantics of programming languages
2. To understand data, data types, and basic statements
3. To understand call-return architecture and ways of implementing them
4. To understand object-orientation, concurrency, and event handling in programming languages
5. To develop programs in non-procedural programming paradigms

**UNIT I SYNTAX AND SEMANTICS 9**

Evolution of programming languages – describing syntax – context-free grammars – attribute grammars – describing semantics – lexical analysis – parsing – recursive-decent – bottom-up parsing

**UNIT II DATA, DATA TYPES, AND BASIC STATEMENTS 9**

Names – variables – binding – type checking – scope – scope rules – lifetime and garbage collection – primitive data types – strings – array types – associative arrays – record types – union types – pointers and references – Arithmetic expressions – overloaded operators – type conversions – relational and boolean expressions – assignment statements – mixed-mode assignments – control structures – selection – iterations – branching – guarded statements

**UNIT III SUBPROGRAMS AND IMPLEMENTATIONS 9**

Subprograms – design issues – local referencing – parameter passing – overloaded methods – generic methods – design issues for functions – semantics of call and return – implementing simple subprograms – stack and dynamic local variables – nested subprograms – blocks – dynamic scoping

**UNIT IV OBJECT-ORIENTATION, CONCURRENCY, AND EVENT HANDLING 9**

Object-orientation – design issues for OOP languages – implementation of object-oriented constructs – concurrency – semaphores – monitors – message passing – threads – statement level concurrency – exception handling – even handling

**UNIT V FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES 9**

Introduction to lambda calculus – fundamentals of functional programming languages – Programming with Scheme – Programming with ML – Introduction to logic and logic programming – Programming with Prolog – multi-paradigm languages

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon Completion of the course, the students will be able to

1. Describe syntax and semantics of programming languages
2. Explain data, data types, and basic statements of programming languages
3. Design and implement subprogram constructs
4. Apply object-oriented, concurrency, and event handling programming constructs
5. Develop programs in Scheme, ML, and Prolog
6. Understand and adopt new programming languages

**REFERENCES:**


1. Robert W. Sebesta, “Concepts of Programming Languages”, Tenth Edition, Addison Wesley, 2012.
2. Michael L. Scott, “Programming Language Pragmatics”, Third Edition, Morgan Kaufmann, 2009.
3. R. Kent Dybvig, “The Scheme programming language”, Fourth Edition, MIT Press, 2009.
4. Jeffrey D. Ullman, “Elements of ML programming”, Second Edition, Prentice Hall, 1998.
5. Richard A. O’Keefe, “The craft of Prolog”, MIT Press, 2009.
6. W. F. Clocksin and C. S. Mellish, “Programming in Prolog: Using the ISO Standard”, Fifth Edition, Springer, 2003.

**IF7005 MULTIMEDIA TECHNOLOGIES L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To familiarize with various elements of multimedia
- To understand the functions of the various of elements in multimedia
- To understand the various multimedia systems
- To learn to use various tools for developing multimedia
- To learn to develop a multimedia application

**UNIT I INTRODUCTION 7**

Introduction to Multimedia – Characteristics – Utilities – Creation -Uses – Promotion – Digital Representation – Media and Data streams – Multimedia Architecture – Multimedia Documents

**UNIT II ELEMENTS OF MULTIMEDIA 11**

**Multimedia Building Blocks:** Text, Graphics, Video Capturing, Sound Capturing, and Editing- Intro to 2D & 3D Graphics -surface characteristics and texture - lights – Animation :key frames & Tweening, techniques, principles of animation, 3Danimation, file formats.

**UNIT III MULTIMEDIA SYSTEMS 9**

Visual Display Systems – CRT - video adapter card - video adapter cable – LCD – PDP - optical storage media - CD technology - DVD Technology - Compression Types and Techniques – CODEC - GIF coding standards – lossy and lossless – JPEG - MPEG-1 - MPEG-2 - MP3 - Fractals – MMDBS

**UNIT IV MULTIMEDIA TOOLS 9**

Authoring tools – features and types - card and page based tools - icon and object based tools - time based tools - cross platform authoring tools – Editing tools - text editing and word processing tools - OCR software - painting and drawing tools - 3D modeling and animation tools - image editing tools –sound editing tools - digital movie tools – plug -ins and delivery vehicles for www

**UNIT V MULTIMEDIA APPLICATION DEVELOPMENT 9**

Software life cycle – ADDIE Model – conceptualization – content collection and processing – story – flowline – script - storyboard - implementation - multiplatform issues – authoring – metaphors – testing – report writing - documentation - case study: -Web Application – Console Application – Distributed Application – Mobile Application - games consoles – iTV – kiosks – education.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon Completion of the course, the students should be able to:

- Design a multimedia architecture for handling the stream
- Work with the various elements of multimedia system
- Develop multimedia stream for the various standards
- Develop animation, images, Sound using Multimedia Tools.
- Develop a multimedia application

**REFERENCES:**


1. Parekh R “Principles Of Multimedia” Tata McGraw-Hill, 2006.
2. Ralf Steinmetz, Klara Nahrstedt, “Multimedia: Computing, Communications and Applications” Prentice Hall, 1995.
3. John Villamil and Louis Molina, “Multimedia ; An Introduction”, Prentice Hall, New Delhi 1998.
4. Tay Vaughan, “Multimedia: Making It Work” McGraw-Hill Professional, 2006
5. Deitel & Deitel “Internet & World Wide Web How to Program”, Fourth Edition – Prentice Hall, 2008
6. BANERJI ASHOK & GHOSH ANANDA MOHAN, Multimedia Technologies, TMH, New Delhi, 2010
7. Li, Ze-Nian & Drew-Mark S, “Fundamentals Of Multimedia,” Phi Learning Private Limited, New Delhi, 2012

**IF7006 AUTOMATA THEORY AND COMPILER DESIGN L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To understand a finite automata for a given language.
- To understand the principle of a Turing machine
- To understand the relation between grammar and language
- To understand the basic principles of working of a compiler
- To study about the type checking procedure during the compilation
- To understand the storage structure of the running program
- To understand the various scope of optimization techniques used in compiler design

**UNIT I AUTOMATA 9**

Introduction to formal proof – Additional forms of proof – Inductive proofs –Finite Automata (FA) – Deterministic Finite Automata (DFA) – Non-deterministic Finite Automata (NFA) – Finite Automata with Epsilon transitions - Equivalence and minimization of Automata**.**

**UNIT II CONTEXT FREE GRAMMARS AND LANGUAGES 9**

Context-Free Grammar (CFG) – Parse Trees – Ambiguity in grammars and languages – Definition of the Pushdown automata – Languages of a Pushdown Automata – Equivalence of Pushdown automata and CFG– Deterministic Pushdown Automata- Normal forms for CFG – Pumping Lemma for CFL – Closure Properties of CFL – Turing Machines – Programming Techniques for TM.

**UNITIII BASICS OF COMPILATION 9**

Compilers – Analysis of source program – Phases of a compiler – Grouping of phases – Compiler construction tools – Lexical Analyzer : Token Specification – Token Recognition – A language for Specifying lexical analyzer – Top down parser : Table implementation of Predictive Parser – Bottom up Parser : SLR(1) Parser – Parser generators.

**UNIT IV TYPE CHECKING AND RUNTIME ENVIRONMENTS 9**

Syntax directed definitions – Construction of syntax trees – Type systems – Specification of a simple type checker- Equivalence of type expressions – Type conversions – Attribute grammar for a simple type checking system – Runtime Environments : Source language issues – Storage organization – Storage allocation strategies – Parameter passing.

**UNIT V CODE GENERATION AND OPTIMIZATION 9**

Issues in the design of a code generator - The target machine - Run-time storage management - Basic blocks and flow graphs - Next-use information - A simple code generator - Register allocation and assignment - The dag representation of basic blocks - Generating code from DAG – Dynamic programming code generation algorithm – Code generator generators - The principle sources of optimization - Peephole optimization - Optimization of basic blocks - Loops in flow graphs - Introduction to global data - flow analysis - Iterative solutions of data flow equations - Code improving transformations

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon completion of the course, the students should be able to :

- Design a finite automaton for a specific language.
- Design a Turing machine.
- Select appropriate grammar for the implementation of compiler phases
- Design a lexical analyzer
- Design a simple parser
- Design and implement techniques used for optimization by a compiler.
- Write a very simple code generator

**REFERENCES:**
1. J.E. Hopcroft, R. Motwani and J.D. Ullman, "Introduction to Automata Theory, Languages and Computations", Second Edition, Pearson Education, 2007.
2. H.R. Lewis and C.H. Papadimitriou, "Elements of the theory of Computation", Second Edition, Pearson Education, 2003.
3. Thomas A. Sudkamp," An Introduction to the Theory of Computer Science, Languages and Machines", Third Edition, Pearson Education, 2007.
4. Raymond Greenlaw an H.James Hoover, " Fundamentals of Theory of Computation, Principles and Practice", Morgan Kaufmann Publishers, 1998.
5. Micheal Sipser, "Introduction of the Theory and Computation", Thomson Brokecole, 1997.
6. J.Martin, "Introduction to Languages and the Theory of computation" Third Edition, Tata Mc Graw Hill, 2007
7.. Alfred V. Aho, Monica S.Lam, Ravi Sethi, Jeffrey D.Ullman, "Compilers :Principles, Techniques and Tools", Second Edition, Pearson Education,2008.
8. Randy Allen, Ken Kennedy, "Optimizing Compilers for Modern Architectures: A Dependence-based Approach", Morgan Kaufmann Publishers, 2002.
9. Steven S. Muchnick, "Advanced Compiler Design and Implementation", Morgan Kaufmann Publishers - Elsevier Science, India, Indian Reprint 2003.

**SE7204 BIG DATA ANALYTICS L T P C**
**3 0 0 3**

**OBJECTIVES**

- To explore the fundamental concepts of big data analytics
- To learn to analyze the big data using intelligent techniques.
- To understand the various search methods and visualization techniques.
- To learn to use various techniques for mining data stream.
- To understand the applications using Map Reduce Concepts.

**UNIT I INTRODUCTION TO BIG DATA 8**

Introduction to BigData Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting - Modern Data Analytic Tools - Statistical Concepts: Sampling Distributions - Re-Sampling - Statistical Inference - Prediction Error.

**UNIT II DATA ANALYSIS 11**

Regression Modeling - Multivariate Analysis – Bayesian Methods – Bayesian Paradigm - Bayesian Modeling - Inference and Bayesian Networks - Support Vector and Kernel Methods - Analysis of Time Series: Linear Systems Analysis - Nonlinear Dynamics - Rule Induction - Fuzzy Logic: Extracting Fuzzy Models from Data - Fuzzy Decision Trees

**UNIT III SEARCH METHODS AND VISUALIZATION 9**

Search by simulated Annealing – Stochastic, Adaptive search by Evaluation – Evaluation Strategies – Genetic Algorithm – Genetic Programming – Visualization – Classification of Visual Data Analysis Techniques – Data Types – Visualization Techniques – Interaction techniques – Specific Visual data analysis Techniques.

**UNIT IV MINING DATA STREAMS 8**

Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.

**UNIT V FRAMEWORKS 9**

Map Reduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed File Systems – Case Study.

**TOTAL:45 PERIODS**

**OUTCOMES:**

At the end of this course the students will be able to:

- Work with big data platform and its analysis techniques.
- Analyze the big data for useful business applications.
- Select visualization techniques and tools to analyze big data
- Implement search methods and visualization techniques
- Design efficient algorithms for mining the data from large volumes.
- Explore the technologies associated with big data analytics such as NoSQL, Hadoop and Map Reduce.

**REFERENCES:**


1. Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, 2007.
2. Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
3. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, John Wiley & sons, 2012.
4. Glenn J. Myatt, “Making Sense of Data”, John Wiley & Sons, 2007
5. Pete Warden, “Big Data Glossary”, O’Reilly, 2011.
6. Jiawei Han, Micheline Kamber “Data Mining Concepts and Techniques”, Second Edition, Elsevier, Reprinted 2008.
7. Da Ruan, Guoquing Chen, Etienne E.Kerre, Geert Wets, Intelligent Data Mining, Springer,2007
8. Paul Zikopoulos ,Dirk deRoos , Krishnan Parasuraman , Thomas Deutsch , James Giles, David Corrigan , Harness the Power of Big Data The IBM Big Data Platform, Tata McGraw Hill Publications, 2012
9. Michael Minelli (Author), Michele Chambers (Author), Ambiga Dhiraj (Author) , Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today’s Businesses,Wiley Publications,2013
10. Zikopoulos, Paul, Chris Eaton, Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, Tata McGraw Hill Publications, 2011


**IF7007 SOFTWARE QUALITY AND TESTING L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To explore the basics and goals of software testing.
- To discuss various types of software testing and its techniques
- To list out various tools which can be used for automating the testing process
- To introduce various software quality standards for establishing quality environment
- To discuss various methods and evaluation procedures for improving the quality models

**UNIT I INTRODUCTION 9**

Basics of Software Testing – Testing Principles – Goals – Testing Life Cycle– Phases of Testing– Test Plan(IEEE format) – Importance of Testing in Software Production Cycle.

**UNIT II SOFTWARE TESTING METHODOLOGY 9**

Software Test Plan – Components of Plan - Types of Technical Reviews - Static and Dynamic Testing- – Software Testing in Spiral Manner - Information Gathering - Test Planning - Test Case Design - Test Development - Test Coverage - Test Evaluation - Prepare for Next Spiral - Conduct System Test - Acceptance Test - Summarize Testing Results.

**UNIT III EMERGING SPECIALIZED AREAS IN TESTING 9**

Test Process Assessment – Test Automation Assessment - Test Automation Framework – Nonfunctional Testing – SOA Testing – Agile Testing – Testing Center of Excellence – Onsite/Offshore Model - Taxonomy of Testing tools, Methodology to evaluate automated testing tools, Rational Testing Tools, Java Testing Tools, JMetra, JUNIT and Cactus.

**UNIT IV SOFTWARE QUALITY MODELS 9**

Software quality –Verification versus Validation– Components of Quality Assurance – SQA Plan – Quality Standards – CMM – PCMM – CMMI – Malcolm Baldrige National Quality Award.

**UNIT V QUALITY THROUGH CONTINUOUS IMPROVEMENT PROCESS 9**

Role of Statistical Methods in Software Quality – Transforming Requirements into Test Cases – Deming's Quality Principles – Continuous Improvement through Plan Do Check Act (PDCA).

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon Completion of the course, the students should be able to

- Compare and pick out the right type of software testing process for any given real world problem
- Carry out the software testing process in efficient way
- Automate the testing process by using several testing tools
- Establish a quality environment as specified in standards for developing quality software
- Analyze and improve the quality procedures based on the past experience

**REFERENCES:**


1. William E.Lewis, "Software Testing and Continuous Quality Improvement", Third edition, Auerbach Publications, 2011.
2. Kshirasagar Naik, Priyadarshi Tripathy, "Software Testing and Quality Assurance -Theory and Practice", John Wiley & Sons publication, 2011.
3. Ron Patton, "Software testing", Second edition, Pearson Education, 2007
4. Elfriede Dustin, Jeff Rashka, John Paul, "Automated Software Testing: Introduction, Management and Performance", Addison-Wesley, 1999.
5. Effective Methods for Software Testing, 2nd Edition, William E. Perry , Second Edition, Wiley India, 2006.
6. Software Testing Tools, K.V.K.K. Prasad, Dream tech press, 2008
7. Testing and Quality Assurance for Component-based Software, by Gao, Tsao and Wu, Artech House Publishers
8. Software Testing, Srinivasan Desikan & Gopalaswamy Ramesh, Pearson Education, 2006.
9. Software Testing Techniques, Scott Loveland & Geoffrey Miller, Shroff Publishers, 2005.
10. Software Testing Techniques, by Bories Beizer, Second Edition, Dreamtech Press Managing the Testing Process, by Rex Black, Wiley

**NC7202 WIRELESS ADHOC AND SENSOR NETWORKS L T P C**
**3 0 0 3**

**UNIT I ADHOC NETWORKS AND ROUTING PROTOCOLS 9**

Ad hoc Wireless Networks – What is an Ad Hoc Network? Heterogeneity in Mobile Devices – Wireless Sensor Networks – Traffic Profiles – Types of Ad hoc Mobile Communications – Types of Mobile Host Movements – Challenges Facing Ad hoc Mobile Networks – Ad hoc wireless Internet . Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks – Classifications of Routing Protocols – Table–Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV) – Wireless Routing Protocol (WRP) – Cluster Switch Gateway Routing (CSGR) – Source–Initiated On–Demand Approaches – Ad hoc On–Demand Distance Vector Routing (AODV) – Dynamic Source Routing (DSR) –Temporally Ordered Routing Algorithm (TORA) – Signal Stability Routing (SSR) –Location–Aided Routing (LAR) – Power–Aware Routing (PAR) – Zone Routing Protocol (ZRP).

**UNIT II MULTICAST ROUTING AND SECURITY 9**

Issues in Designing a Multicast Routing Protocol – Operation of Multicast Routing Protocols – An Architecture Reference Model for Multicast Routing Protocols –Classifications of Multicast Routing Protocols – Tree–Based Multicast Routing Protocols– Mesh–Based Multicast Routing Protocols – Summary of Tree and Mesh based Protocols – Energy–Efficient Multicasting – Multicasting with Quality of Service Guarantees – Application – Dependent Multicast Routing –
Comparisons of Multicast Routing Protocols - Design Goals of a Transport Layer Protocol for Ad hoc Wireless Networks –Classification of Transport Layer Solutions – TCP over Ad hoc Wireless Networks- Security in Ad Hoc Wireless Networks – Network Security Requirements – Issues and Challenges in Security Provisioning – Network Security Attacks – Key Management – Secure Routing in Ad hoc Wireless Networks.

**UNIT III QoS AND ENERGY MANAGEMENT 9**

Issues and Challenges in Providing QoS in Ad hoc Wireless Networks – Classifications of QoS Solutions – MAC Layer Solutions – Network Layer Solutions – QoS Frameworks for Ad hoc Wireless Networks Energy Management in Ad hoc Wireless Networks – Introduction – Need for Energy Management in Ad hoc Wireless Networks – Classification of Energy Management Schemes – Battery Management Schemes – Transmission Power Management Schemes – System Power Management Schemes.

**UNIT IV SENSOR NETWORKS – ARCHITECTUREAND MACPROTOCOLS 9**

Single node architecture – Hardware components, energy consumption of sensor nodes, Network architecture – Sensor network scenarios, types of sources and sinks, single hop versus multi-hop networks, multiple sinks and sources, design principles, Development of wireless sensor networks. , physical layer and transceiver design consideration in wireless sensor networks, Energy usage profile, choice of modulation, Power Management - MAC protocols – fundamentals of wireless MAC protocols, low duty cycle protocols and wakeup concepts, contention-based protocols, Schedule-based protocols - SMAC, BMAC, Traffic-adaptive medium access protocol (TRAMA), Link Layer protocols – fundamentals task and requirements, error control, framing, link management.

**UNIT V SENSOR NETWORKS – ROUTING PROTOCOLS AND OPERATING SYSTEMS 9**

Gossiping and agent-based uni-cast forwarding, Energy-efficient unicast, Broadcast and multicast, geographic routing, mobile nodes, Data-centric routing – SPIN, Directed Diffusion, Energy aware routing, Gradient-based routing – COUGAR, ACQUIRE, Hierarchical Routing – LEACH, PEGASIS, Location Based Routing – GAF, GEAR, Data aggregation – Various aggregation techniques. Introduction to TinyOS – NesC, Interfaces, modules, configuration, Programming in TinyOS using NesC, Emulator TOSSIM.

**TOTAL: 45 PERIODS**

**REFERENCES:**
1. C. Siva Ram Murthy and B. S. Manoj, “Ad Hoc Wireless Networks Architectures and Protocols”, Prentice Hall, PTR, 2004.
2. C. K. Toh, “Ad Hoc Mobile Wireless Networks Protocols and Systems”, Prentice Hall, PTR, 2001.
3. Charles E. Perkins, “Ad Hoc Networking”, Addison Wesley, 2000.
4. Kazem Sohraby, Daniel Minoli and Taieb Znati, “ Wireless Sensor Networks Technology- Protocols and Applications”, John Wiley & Sons, 2007.
5. Feng Zhao, Leonidas Guibas, “Wireless Sensor Networks: an information processing approach”, Else vier publication, 2004.
6. C.S.Raghavendra Krishna, M.Sivalingam and Tarib znati, “Wireless Sensor Networks”, Springer publication, 2004.
7. Holger Karl , Andreas willig, “Protocol and Architecture for Wireless Sensor Networks”, John wiley publication, Jan 2006.
8. K.Akkaya and M.Younis, “ A Survey of routing protocols in wireless sensor networks”, Elsevier Adhoc Network Journal, Vol.3, no.3,pp. 325-349, 2005.
9. Philip Levis, “ TinyOS Programming”, 2006 – www.tinyos.net.
10. I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, “Wireless sensor networks: a survey”, computer networks, Elsevier, 2002, 394 - 422.
11. Jamal N. Al-karaki, Ahmed E. Kamal, “Routing Techniques in Wireless sensor networks: A survey”, IEEE wireless communication, December 2004, 6 – 28.

**IF7008 WEB MINING L T P C**
**3 0 0 3**

**OBJECTIVES:**
- To understand the different knowledge discovery issues in data mining from the world wide web.
- To analyze the different algorithms commonly used by Web application.
- To apply the role played by Web mining in Information retrieval and extraction
- To learn the documents structures and grouping
- To learn to use the probabilistic model for web mining
- To learn to develop applications using Web mining

**UNIT I INTRODUCTION 9**

Overview of Data mining – Data mining from a Business Perspective – Data types, Input and output of data mining algorithms- Decision Tree- Classification and Regression Trees – Preprocessing and Post processing in Data mining

**UNIT II INFORMATION RETRIEVAL 9**

Information Retrieval and Text Mining - Keyword Search - Nearest-Neighbor Methods - Measuring Similarity - Web-Based Document Search - Document–Matching - Inverted Lists - Evaluation of Performance - Structure in a Document Collection - Clustering Documents by Similarity- Evaluation of Performance - Information Extraction - Patterns and Entities from Text- Co reference and Relationship Extraction - Template Filling and Database Construction

**UNIT III WEB SEARCH 9**

Crawling the web – HTML and HTTP Basics – Crawling Basics – Engineering Large Scale Crawlers- Putting together a Crawler- Boolean Queries and the Inverted Index – Relevance Ranking – Similarity Search

**UNIT IV LEARNING 9**

Similarity and Clustering – Formulations and approaches- Bottom up and Top down Partitioning Paradigms – Clustering and Visualization via Embeddings – Probabilistic Approaches to clustering – Collaborative Filtering – Supervised Learning – Semi Supervised Learning

**UNIT V APPLICATIONS 9**

Social Network Analysis- Social Sciences and Bibliometry – Page Rank and HITS – Short comings of coarse Grained Graph model- Enhanced Models and Techniques- Evaluation of Topic Distillation- Measuring and Modeling the Web – Resource Discovery – Collecting Important Pages Preferentially – Similarity Search Using Link Topology – Topical Locality and Focused Crawling – Discovering Communities- The Future of Web Mining.

**TOTAL:45 PERIODS**

**OUTCOMES:**

At the end of the course the student should be able to:

- Identify the application areas for web content mining, web structure mining and web usage mining.
- Design to retrieval the web data
- Develop schemes to crawl the web data, organize and index
- Cluster the documents for fast access
- Develop algorithms used by web mining applications.
- Select between different approaches and techniques of web mining

**REFERENCES :**


1. Sholom Weiss, “Text Mining: Predictive Methods for Analyzing Unstructured Information”, Springer, 2005
2. Hercules Antonio do Prado, Edilson Fernada, “ Emerging Technologies of Text Mining: Techniques and Applications”, Information Science Reference (IGI), 2008
3. Min Song, Yi-fang Brrok Wu, “Handbook of Research on Text and Web Mining Technologies”, Vol I & II, Information Science Reference (IGI),2009
4. Soumen Chakrabarti “ Mining the Web : Discovery Knowledge from Hypertext Data“ Elsevier Science 2003
5. K.P.Soman,Shyam Diwakar, V.Ajay “ Insight into Data Mining Theory and Practice “ Prentice Hall of India Private Ltd 2006
6. Anthony Scime, “Web Mining Applications and Techniques”, Idea Group Publishing, 2005
7. Margret H.Dunham “DATA MINING - Introductory and Advanced Concepts”, Pearson Education,2003.
8. R. Kosala and H. Blockeel, “Web Mining Research: A Survey”, SIGKDD Exploration, vol. 2, issue 1, 2000.
9. J. Srivastava et al, “Web Usage Mining: Discovery and Applications of Usage Patterns from Web Data”, SIGKDD Exploration, vol. 2, issue 1, 1999


**IF7009 IMAGE PROCESSING AND PATTERN ANALYSIS L T P C**
**3 0 0 3**

**OBJECTIVES:**

To introduce the student to various Image processing and Pattern recognition techniques.

- To study the Image fundamentals.
- To study the mathematical morphology necessary for Image processing and Image segmentation.
- To study the Image Representation and description and feature extraction.
- To study the principles of Pattern Recognition.
- To know the various applications of Image processing.

**UNIT I INTRODUCTION 9**

Elements of an Image Processing System- Mathematical Preliminaries- Image Enhancement- Grayscale Transformation- Piecewise Linear Transformation-Bit Plane Slicing- Histogram Equalization--Histogram Specification- Enhancement by Arithmetic Operations- Smoothing Filter- Sharpening Filter- Image Blur Types and Quality Measures.

**UNIT II MATHEMATICAL MORPHOLOGY and IMAGE SEGMENTATION 9**

Binary Morphology-Opening and Closing- Hit-or-Miss Transform- Grayscale Morphology- Basic morphological Algorithms- Morphological Filters-Thresholding-Object (Component) Labeling-Locating Object Contours by the Snake Model- Edge Operators-Edge Linking by Adaptive Mathematical morphology- Automatic Seeded Region Growing- A Top-Down Region Dividing Approach.

**UNIT III IMAGE REPRESENTATION AND DESCRIPTION and FEATURE EXTRACTION 9**

Run-Length Coding- Binary Tree and Quadtree- Contour Representation-Skeletonization by Thinning- Medial Axis Transformation-Object Representation and Tolerance- Fourier Descriptor and Moment Invariants-Shape Number and Hierarchical Features-Corner Detection- Hough Transform-Principal Component Analysis-Linear Discriminate Analysis- Feature Reduction in Input and Feature Spaces.

**UNIT IV PATTERN RECOGNITION 9**

The Unsupervised Clustering Algorithm-Bayes Classifier- Support Vector Machine- Neural Networks-The Adaptive Resonance Theory Network-Fuzzy Sets in Image Analysis-Document image processing and classification-Block Segmentation and Classification- Rule-Based Character Recognition system- Logo Identification-Fuzzy Typographical Analysis for Character Pre classification-Fuzzy Model for Character Classification.

**UNIT V APPLICATIONS: 9**

Face and Facial Feature Extraction-Extraction of Head and Face Boundaries and Facial Features-Recognizing Facial Action Units-Facial Expression Recognition in JAFFE Database-Image Steganography- Types of Steganography- Applications of Steganography- Embedding Security and Imperceptibility- Examples of Steganography Software-Genetic Algorithm Based Steganography.

**TOTAL:45 PERIODS**

**OUTCOMES:**

Upon Completion of the course, the students will be able to:

- Process the image for better appearance.
- Segment the image using different techniques
- Represent the images in different forms
- Develop algorithms for Pattern Recognition
- Extract and deploy the features in various Image processing applications

**REFERENCES:**


1. Image Processing and Pattern Recognition: Fundamentals and Techniques- Frank Y Shih, Willey IEEE Press, April 2010
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins," Digital Image Processing using MATLAB", Pearson Education, Inc., 2004.
3. D.E. Dudgeon and R.M. Mersereau, "Multidimensional Digital Signal Processing", Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, " Digital Image Processing", John Wiley, New York, 2002.
5. Milan Sonka et al, "Image Processing, Analysis and Machine Vision", Brookes/Cole, Vikas Publishing House, 2nd edition, 1999;
6. Sid Ahmed, M.A., " Image Processing Theory, Algorithms and Architectures", McGrawHill, 1995

**IF7010** **INTELLIGENT AGENTS** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To understand the basics of User Interface Design.
- To design the user interface, design, menu creation and windows creation
- To understand the concept of menus, windows, interfaces, business functions, various problems in windows design with color, text, Non-anthropomorphic Design.
- To study the design process and evaluations.

**UNIT I AGENTS – OVERVIEW** **9**

Agent Definition – Agent Programming Paradigms – Agent Vs Object – Aglet – Mobile Agents – Agent Frameworks – Agent Reasoning.

**UNIT II JAVA AGENTS** **9**

Processes – Threads – Daemons – Components – Java Beans – ActiveX – Sockets – RPCs – Distributed Computing – Aglets Programming – Jini Architecture – Actors and Agents – Typed and proactive messages.

**UNIT III MULTIAGENT SYSTEMS** **9**

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 IV INTELLIGENT SOFTWARE AGENTS** **9**

Interface Agents – Agent Communication Languages – Agent Knowledge Representation – Agent Adaptability – Belief Desire Intension – Mobile Agent Applications**.**

**UNIT V MOBILE AGENTS AND SECURITY** **9**

Mobile Agent Paradigm - Mobile Agent Concepts -Mobile Agent Technology-Agent Security Issues – Mobile Agents Security – Protecting Agents against Malicious Hosts – Untrusted Agent – Black Box Security – Authentication for agents

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Understand the notion of an agent, how agents are distinct from other software paradigms
- Knowledge on the characteristics of applications that lend themselves to an agent-oriented solution.
- Know the key issues associated with constructing agents capable of intelligent autonomous actions.
- Learn the main application areas of agent-based solutions, and be able to develop a meaningful agent-based system using a contemporary agent development platform.

**REFERENCES:**


1. Bigus & Bigus, " Constructing Intelligent agents with Java ", Wiley, 1997.
2. Bradshaw, " Software Agents ", MIT Press, 2000.
3. Russel, Norvig, "Artificial Intelligence: A Modern Approach", Second Edition, Pearson
4. Education, 2003.
5. Richard Murch, Tony Johnson, "Intelligent Software Agents", Prentice Hall, 2000.
6. Gerhard Weiss, “Multi Agent Systems – A Modern Approach to Distributed Artificial Intelligence”, MIT Press, 2000.
7. William R. Cockayne, Michael Zyda, "Mobile Agents", Prentice Hall, 1998

**IF7011** **INTERNET OF THINGS** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To learn the basic issues, policy and challenges in the Internet
- To understand the components and the protocols in Internet
- To build a small low cost embedded system with the internet
- To understand the various modes of communications with internet
- To learn to manage the resources in the Internet
- To deploy the resources into business
- To understand the cloud and internet environment.

**UNIT I INTRODUCTION** **9**

Definition – phases – Foundations – Policy– Challenges and Issues - identification - security – privacy. Components in internet of things**:** Control Units – Sensors – Communication modules – Power Sources – Communication Technologies – RFID – Bluetooth – Zigbee – Wifi – Rflinks – Mobile Internet – Wired Communication

**UNIT II PROGRAMMING THE MICROCONTROLLER FOR IOT** **9**

Basics of Sensors and actuators – examples and working principles of sensors and actuators – Cloud computing and IOT – Arduino/Equivalent Microcontroller platform – Setting up the board - Programming for IOT – Reading from Sensors

**Communication:** Connecting microcontroller with mobile devices – communication through bluetooth and USB – connection with the internet using wifi / ethernet

**UNIT III RESOURCE MANAGEMENT IN THE INTERNET OF THINGS** **9**

Clustering - Software Agents - Data Synchronization - Clustering Principles in an Internet of Things Architecture - The Role of Context - Design Guidelines -Software Agents for Object - Data Synchronization- Types of Network Architectures - Fundamental Concepts of Agility and Autonomy-Enabling Autonomy and Agility by the Internet of Things-Technical Requirements for Satisfying the New Demands in Production - The Evolution from the RFID-based EPC Network to an Agent based Internet of Things- Agents for the Behaviour of Objects

**UNIT IV BUSINESS MODELS FOR THE INTERNET OF THINGS** **9**

The Meaning of DiY in the Network Society- Sensor-actuator Technologies and Middleware as a Basis for a DiY Service Creation Framework - Device Integration - Middleware Technologies Needed for a DiY Internet of Things Semantic Interoperability as a Requirement for DiY Creation -Ontology- Value Creation in the Internet of Things-Application of Ontology Engineering in the Internet of Things-Semantic Web-Ontology - The Internet of Things in Context of EURIDICE - Business Impact

**UNIT V FROM THE INTERNET OF THINGS TO THE WEB OF THINGS:** **9**

Resource-oriented Architecture and Best Practices- Designing REST ful Smart Things - Web-enabling Constrained Devices - The Future Web of Things - Set up cloud environment – send data from microcontroller to cloud – Case studies – Open Source e-Health sensor platform – Be Close Elderly monitoring – Other recent projects.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

At the end of this course the students will be able to:

- Identify the components of IOT
- Design a portable IOT using appropriate boards
- Program the sensors and controller as part of IOT
- Develop schemes for the applications of IOT in real time scenarios
- Establish the communication to the cloud through wifi/ Bluetooth
- Manage the internet resources
- Model the Internet of things to business

**REFERENCES:**


1. Charalampos Doukas , Building Internet of Things with the Arduino, Create space, April 2002
2. Dieter Uckelmann et.al, “Architecting the Internet of Things”, Springer, 2011
3. Luigi Atzor et.al, “The Internet of Things: A survey, “, Journal on Networks, Elsevier Publications, October, 2010
4. http://postscapes.com/
5. http://www.theinternetofthings.eu/what-is-the-internet-of-things


**NE7003 WEB ENGINEERING L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To understand the issues and process of Web design.
- To learn the concepts of Web design patterns and page design.
- To understand and learn the scripting languages with design of web applications.
- To learn the maintenance and evaluation of web design management.

**UNIT I INTRODUCTION TO WEB ENGINEERING 9**

History of web Development, Evolution and Need for Web Engineering, World Wide Web, Introduction to TCP/IP and WAP , DNS, Email, TelNet, HTTP and FTP, Introduction to Browser and search engines, Web Servers, Features of web servers, caching, case study-IIS, Apache, Configuring web servers.

**UNIT II INFORMATION ARCHITECTURE 9**

The role of Information Architect, Collaboration& Communication, Organizing Information, Organizational Challenges, Organizing Web sites parameters and Intranets, Creating Cohesive Websites, Architectural Page Mockups, Design Sketches, Navigation Systems, Searching Systems Good & bad web design, Process of Web Publishing, Phases of Web Site development, Requirements Engineering for Web Applications.

**UNIT III HTML & DHTML 9**

HTML Basic Concept, Static & dynamic HTML, Structure of HTML documents, HTML Elements, Linking in HTML, Anchor Attributes, Image Maps, Meta Information, Image Preliminaries, Layouts, backgrounds, Colors and Text, Fonts, Tables, Frames and layers, Audio and Video Support with HTML Database integration, CSS, Positioning with Style sheets, Forms Control, Form Elements, Introduction to CGI PERL, JAVA SCRIPT, PHP, ASP, Cookies Creating and Reading Cookies.

**UNIT IV XML 9**

Introduction of XML, Validation of XML documents, DTD, Ways to use XML,XML for data files HTML Vs XML, Embedding XML into HTML documents, Converting XML to HTML for Display, Displaying XML using CSS and XSL, Rewriting HTML as XML, Relationship between HTML, SGML and XML, web personalization , Semantic web, Semantic Web Services, Ontology.

**UNITV APPLICATIONS AND SECURITY 9**

E-commerce Business Models, The Internet and World Wide Web, Modes of Electronic Commerce, Approaches to safe Electronic Commerce, Electronic Cash and Electronic Payment Schemes, Online Security and Payment Systems, E-commerce Marketing Concepts, Advertising on the Internet, Electronic Publishing issues, approaches, Legalities & technologies, Privacy & Security, Web Security, Encryption schemes, Secure Web document, Digital Signatures and Firewalls, Cyber crime and laws, IT Act.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon completion of the course, the students will be able to

- Identify the various issues of web design process and evaluation.
- Determine templates for web pages and layout.
- Develop simple web applications using scripting languages.
- Determine the various issues of web project development.
- Address the core issues of web page maintenance and evaluation.

**REFERENCES:**


1. Roger S. Pressman, David Lowe, "Web Engineering", Tata McGraw Hill Publication, 2007
2. Web Engineering: A Practitioner's Approach by Roger Pressman and David Lowe, McGraw-Hill, 2009.
3. Achyut S Godbole and Atul Kahate, "Web Technologies", Tata McGraw Hill
4. NEIL GRAY ,"Web server Programming" Wiley
5. CHRIS BATES Web Programming :Building Internet applications, Wiley
6. Moller, "An Introduction to XML and Web Technologies", Pearson Education New Delhi,2009


**CP7006 PARALLEL PROGRAMMING PARADIGMS L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To understand models of and issues in concurrency in computing
- To develop message-passing parallel programs using MPI
- To develop shared-memory parallel programs using Pthreads
- To develop shared-memory parallel programs using OpenMP
- To use GPU for parallel programming using OpenCL and CUDA

**UNIT I FOUNDATIONS OF PARALLEL PROGRAMMING 9**

Motivation for parallel programming - Concurrency in computing – basics of processes, multiprocessing, and threads – cache – cache mappings – caches and programs – virtual memory – instruction level parallelism – hardware multi-threading – SIMD – MIMD – interconnection networks – cache coherence – shared-memory model – issues in shared-memory model – distributed-memory model – issues in distributed-memory model – hybrid model – I/O – performance of parallel programs – parallel program design

**UNIT II MESSAGE PASSING PARADIGM 9**

Basic MPI programming – MPI_Init and MPI_Finalize – MPI communicators – SPMD programs – message passing – MPI_Send and MPI_Recv – message matching – MPI I/O – parallel I/O – collective communication – MPI_Reduce – MPI_Allreduce – broadcast – scatter – gather – allgather – derived types – remote memory access – dynamic process management – MPI for grids – performance evaluation of MPI programs

**UNIT III SHARED MEMORY PARADIGM: PTHREADS 9**

Basics of Pthreads – thread synchronization – critical sections – busy-waiting – mutexes – semaphores – barriers and condition variables – read-write locks – Caches, cache coherence and false sharing – thread safety – Pthreads case study

**UNIT IV SHARED MEMORY PARADIGM: OPENMP 9**

Basic OpenMP constructs – scope of variabls – reduction clause – parallel for directive – loops in OpenMP – scheduling loops – synchronization in OpenMP – Case Study: Producer-Consumer problem – cache issues – threads safety in OpenMP – OpenMP best practices

**UNIT V GRAPHICAL PROCESSING PARADIGMS: OPENCL AND CUDA 9**

Introduction to CUDA – CUDA programming examples – CUDA execution model – CUDA memory hierarchy – CUDA case study - introduction to OpenCL – OpenCL programming examples – Programs and Kernels – Buffers and Images – Event model – OpenCL case study.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon completion of the course, the students will be able to

- Explain models of parallel programming
- Explain hardware level support for concurrency
- Explain issues in parallel programming
- Develop message-passing parallel programs using MPI framework
- Develop shared-memory parallel programs using Pthreads
- Develop shared-memory parallel programs using OpenMP
- Develop CUDA programs
- Develop OpenCL programs

**REFERENCES:**


1. Peter S. Pacheco, “An introduction to parallel programming”, Morgan Kaufmann, 2011.
2. M. J. Quinn, “Parallel programming in C with MPI and OpenMP”, Tata McGraw Hill, 2003.
3. W. Gropp, E. Lusk, and R. Thakur, “Using MPI-2: Advanced features of the message passing interface”, MIT Press, 1999.
4. W. Gropp, E. Lusk, and A. Skjellum, “Using MPI: Portable parallel programming with the message passing interface”, Second Edition, MIT Press, 1999.
5. B. Chapman, G. Jost, and Ruud van der Pas, “Using OpenMP”, MIT Press, 2008.
6. D. R. Butenhof, “Programming with POSIX Threads”, Addison Wesley, 1997.
7. B. Lewis and D. J. Berg, “Multithreaded programming with Pthreads”, Sun Microsystems Press, 1998.
8. A. Munshi, B. Gaster, T. G. Mattson, J. Fung, and D. Ginsburg, “OpenCL programming guide”, Addison Wesley, 2011.
9. Rob Farber, “CUDA application design and development”, Morgan Haufmann, 2011.


**NE7012 SOCIAL NETWORK ANALYSIS L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To understand the concepts of Social networks and Web Social Networks
- To appreciate the modeling and visualizing techniques associated with Social Networks
- To understand the different techniques used to mine communities from Web Social Networks
- To appreciate concepts of evolution and prediction in Social Networks
- To understand the application of text mining techniques for Content and Opinion mining

**UNIT I INTRODUCTION 9**

Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks.

**UNIT II MODELING AND VISUALIZATION 9**

Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix-Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data **–** Random Walks and their Applications –Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships.

**UNIT III MINING COMMUNITIES 9**

Aggregating and reasoning with social network data, Advanced Representations - Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks.

**UNIT IV EVOLUTION 9**

Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score Propagation – Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction - Bayesian Probabilistic Models - Probabilistic Relational Models

**UNIT V TEXT AND OPINION MINING 9**

Text Mining in Social Networks -Opinion extraction – Sentiment classification and clustering - Temporal sentiment analysis - Irony detection in opinion mining - Wish analysis - Product review mining – Review Classification – Tracking sentiments towards topics over time.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon Completion of the course, the students will be able to

- Build a social network data set from existing social networking sites
- Identify the different components of a web social network that can be used for analyzing and mining
- Identify the different data structures and graph algorithms that can be used for web social network mining
- Implement a community detection algorithm
- Process Social Network data using MapReduce paradigm
- Design an application that uses various aspects of Social Network Mining to improve its functionality and to harvest information available on the web to build recommender systems
- Analyze social media data using appropriate data/web mining techniques

**REFERENCES:**


1. Charu C. Aggarwal, "Social Network Data Analytics", Springer; 2011
2. Peter Mika, "Social Networks and the Semantic Web", Springer, 1st edition 2007.
3. Borko Furht, "Handbook of Social Network Technologies and Applications", Springer, 1st edition, 2010**.**
4. Guandong Xu , Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", Springer, 1st edition, 2011.
5. Giles, Mark Smith, John Yen, "Advances in Social Network Mining and Analysis", Springer, 2010.
6. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, "Computational Social Network Analysis: Trends, Tools and Research Advances", Springer, 2009.
7. Toby Segaran, "Programming Collective Intelligence", O'Reilly, 2012

**IF7012** **KNOWLEDGE ENGINEERING** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To learn about proposition logic and predicate logics.
- To acquire knowledge about modal and non monotonic logics.
- To understand object oriented abstractions for various expert systems.
- To understand various planning strategies for problem solving.
- To explain the basic knowledge representation and problem solving techniques of Artificial Intelligence.
- To understand the uncertainties and expressiveness associated with the knowledge representation
- To study the various actions taken on the knowledge that is represented

**UNIT I INTRODUCTION** **9**

Knowledge Representation and Reasoning – First order Logic – Syntax, Semantics Pragmatics – Expressing Knowledge – Levels of Representation – Knowledge Acquisition and Sharing – Sharing Ontologies – Language Ontologies –Language Patterns – Tools for Knowledge Acquisition

**UNIT II RESOLUTION AND REASONING** **9**

Proportional Case – Handling Variables and Quantifiers – Dealing with Intractability – Reasoning with Horn Clauses - Procedural Control of Reasoning – Rules in Production– Description Logic - Issues in Engineering -Vivid Knowledge – Beyond Vivid.

**UNIT III REPRESENTATION** **9**

Object Oriented Representations – Frame Formalism – Structured Descriptions – Meaning and Entailment - Taxonomies and Classification – Inheritance – Networks – Strategies for Defeasible Inheritance – Formal Account of Inheritance Networks.

**UNIT IV DEFAULTS, UNCERTAINTY AND EXPRESSIVENESS** **9**

Defaults – Introduction – Closed World Reasoning – Circumscription – Default Logic Limitations of Logic – Fuzzy Logic – Nonmontonic Logic – Theories and World – Semiotics – Auto epistemic Logic - Vagueness – Uncertainty and Degrees of Belief – Noncategorical Reasoning – Objective and Subjective Probability.

**UNIT V ACTIONS AND PLANNING** **9**

Explanation and Diagnosis – Purpose – Syntax, Semantics of Context – First Order Reasoning – Modal Reasoning in Context – Encapsulating Objects in Context – Agents – Actions – Situational Calculus – Frame Problem – Complex Actions – Planning – Strips – Planning as Reasoning – Hierarchical and Conditional Planning.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Identify the various components in a knowledge system.
- Apply the Ontology in the representation of knowledge
- Resolve the problem by logical reasoning
- Select appropriate strategies for representing the knowledge
- Resolve uncertainties associated with the knowledge representation
- Deploy the context information for the better interpretation of knowledge

**REFERENCES:**


1. Ronald Brachman, Hector Levesque "Knowledge Representation and Reasoning" The Morgan Kaufmann Series in Artificial Intelligence 2004
2. John F. Sowa, " Knowledge Representation: Logical, Philosophical, and Computational Foundations", 2000.
3. Arthur B. Markman, "Knowledge Representation", Lawrence Erlbaum Associates, 1998
4. Simon Kendal, Malcolm Creen, An Introduction to Knowledge Engineering, Springer, 2007
5. Thomas B.Cross, Knowledge Engineering 2010, Techtionary Corporation, 2010
6. Fred, A., Dietz J.L.G., Liu K., Filipe J., Knowledge Discovery, Knowledge Engineering and Knowledge Management, Springer Publications,2011


**IF7013 ENERGY AWARE COMPUTING LT P C**
**3 0 0 3**

**OBJECTIVES:**

This course examines the design of power efficient architecture, power and performance tradeoffs, restructuring of software and applications and standards for energy aware Hardware and Software. The objective of this course is:

- To know the fundamental principles energy efficient devices
- To study the concepts of Energy efficient storage
- To introduce energy efficient algorithms
- Enable the students to know energy efficient techniques involved to support real-time systems.
- To study Energy aware applications.

**UNIT I INTRODUCTION 9**

Energy efficient network on chip architecture for multi core system-Energy efficient MIPS CPU core with fine grained run time power gating – Low power design of Emerging memory technologies.

**UNIT II ENERGY EFFICIENT STORAGE 9**

Disk Energy Management-Power efficient strategies for storage system-Dynamic thermal management for high performance storage systems-Energy saving technique for Disk storage systems

**UNIT III ENERGY EFFICIENT ALGORITHMS 9**

Scheduling of Parallel Tasks – Task level Dynamic voltage scaling – Speed Scaling – Processor optimization- Memetic Algorithms – Online job scheduling Algorithms.

**UNIT IV REAL TIME SYSTEMS 9**

Multi processor system – Real Time tasks- Energy Minimization – Energy aware scheduling-Dynamic Reconfiguration- Adaptive power management-Energy Harvesting Embedded system.

**UNIT V ENERGY AWARE APPLICATIONS 9**

On chip network – Video codec Design – Surveillance camera- Low power mobile storage.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon Completion of the course, the students will be able to

- Design Power efficient architecture Hardware and Software.
- Analyze power and performance trade off between various energy aware storage devices.
- Implement various energy aware algorithms.
- Restructure the software and Hardware for Energy aware applications.
- Explore the Energy aware applications

**REFERENCES:**


1. Ishfaq Ah mad, Sanjay Ranka, Handbook of Energy Aware and Green Computing, Chapman and Hall/CRC, 2012
2. Chong-Min Kyung, Sungioo yoo, Energy Aware system design Algorithms and Architecture, Springer, 2011.
3. Bob steiger wald ,Chris:Luero, Energy Aware computing, Intel Press,2012.


**IF7014 4G TECHNOLOGIES L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To learn various generations of wireless and cellular networks
- To study about fundamentals of 3G Services, its protocols and applications
- To study about evolution of 4G Networks, its architecture and applications
- To study about WiMAX networks, protocol stack and standards
- To Study about Spectrum characteristics & Performance evaluation

**UNIT I INTRODUCTION 9**

Introduction: History of mobile cellular systems, First Generation, Second Generation, Generation 2.5, Overview of 3G & 4G, 3GPP and 3GPP2 standards

**UNIT II 3G NETWORKS 9**

3G Networks: Evolution from GSM, 3G Services & Applications, UMTS network structure, Core network, UMTS Radio access, HSPA – HSUPA, HSDPA, CDMA 1X , EVDO Rev -0, Rev-A, Rev-B, Rev-C Architecture, protocol stack.

**UNIT III 4G LTE NETWORKS 9**

4G Vision, 4G features and challenges, Applications of 4G, 4G Technologies – Multi carrier modulation, Smart Antenna Techniques, OFDM-MIMO Systems, Adaptive Modulation and Coding with Time-Slot Scheduler, Bell Labs Layered Space Time (BLAST) System, Software-Defined Radio, Cognitive Radio**.**

**UNIT IV WiMAX NETWORKS 9**

WiMax: Introduction – IEEE 802.16, OFDM, MIMO, IEEE 802.20

**UNIT V SPECTRUM & PERFORMANCE 9**

Spectrum for LTE-Flexibility-Carrier Aggregation-Multi standard Radio base stations-RF requirements for LTE-Power level requirements-Emission requirements-Sensitivity and Dynamic range-Receiver susceptibility. Performance Assessment-Performance Evaluation

**TOTAL:45 PERIODS**

**OUTCOMES:**

Upon completion of the course, the students should be able to:

- Acquaint with the latest 3G/4G and WiMAX networks and its architecture.
- Interpret the various protocols and standards in various layers in Wireless networks.
- Design and implement wireless network environment for any application using latest wireless protocols and standards
- Analyze the performance of networks
- Explore the benefits of WiMax networks
- Exploit various diversity schemes in LTE

**REFERENCES:**


1. Introduction to 3G Mobile Communication, Juha Korhonen, Artech House, (www.artechhouse.com), Jan 2003, ISBN-10: 1580535070
2. 4G LTE/LTE – Advanced for Mobile Broadband, Erik Dahlman, Stefan Parkvall, Johan Skold, Academic Press 2011.
3. 3G Evolution HSPA and LTE for Mobile Broadband, Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, Academic Press, Oct 2008, ISBN-10: 0123745381
4. UMTS Mobile Communication for the Future, Flavio Muratore, John Wiley & Sons Ltd, Jan 2001, ISBN-10: 0471498297
5. HSDPA/HSUPA for UMTS, Harri Holma and Antti Toskala, Johan Wiley & Sons Ltd, May 2006, ISBN-10: 0470018844
6. Savo G.Glisic, "Advanced Wireless Networks- 4GTechnologies", Wiley, 2006
7. Magnus Olsson, Catherine Mulligan, "EPC and 4G packet network", Elsevier 2012
8. Vijay Garg, "Wireless Communications and Networking", Elsevier, Morgan kufmann publisher 2007.


**CP7001 PERFORMANCE EVALUATION OF COMPUTER SYSTEMS L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To understand the mathematical foundations needed for performance evaluation of computer systems
- To understand the metrics used for performance evaluation
- To understand the analytical modeling of computer systems
- To enable the students to develop new queueing analysis for both simple and complex systems
- To appreciate the use of smart scheduling and introduce the students to analytical techniques for evaluating scheduling policies

**UNIT I OVERVIEW OF PERFORMANCE EVALUATION 9**

Need for Performance Evaluation in Computer Systems – Overview of Performance Evaluation Methods – Introduction to Queueing – Probability Review – Generating Random Variables for Simulation – Sample Paths, Convergence and Averages – Little's Law and other Operational Laws – Modification for Closed Systems.

**UNIT II MARKOV CHAINS AND SIMPLE QUEUES 9**

Discrete-Time Markov Chains – Ergodicity Theory – Real World Examples – Google, Aloha – Transition to Continuous-Time Markov Chain – M/M/1 and PASTA.

**UNIT III MULTI-SERVER AND MULTI-QUEUE SYSTEMS 9**

Server Farms: M/M/k and M/M/k/k – Capacity Provisioning for Server Farms – Time Reversibility and Burke's Theorem – Networks of Queues and Jackson Product Form – Classed and Closed Networks of Queues.

**UNIT IV REAL-WORLD WORKLOADS 9**

Case Study of Real-world Workloads – Phase-Type Distributions and Matrix-Alalytic Methods – Networks with Time-Sharing Servers – M/G/1 Queue and the Inspection Paradox – Task Assignment Policies for Server Farms.

**UNIT V SMART SCHEDULING IN THE M/G/1 9**

Performance Metrics – Scheduling Non-Preemptive and Preemptive Non-Size-Based Policies - . Scheduling Non-Preemptive and Preemptive Size-Based Policies – Scheduling - SRPT and Fairness.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon completion of the course, the students will be able to

1. Identify the need for performance evaluation and the metrics used for it
2. Discuss open and closed queueing networks
3. Deploy Little'e law and other operational laws
4. Apply the operational laws to open and closed systems
5. Use discrete-time and continuous-time Markov chains to model real world systems
6. Develop analytical techniques for evaluating scheduling policies

**REFERENCES:**


1. Mor Harchol - Balter, "Performance Modeling and Design of Computer Systems – Queueing Theory in Action", Cambridge University Press, 2013.
2. Raj Jain, "The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation and Modeling", Wiley-Interscience, 1991.
3. Lieven Eeckhout, "Computer Architecture Performance Evaluation Methods", Morgan and Claypool Publishers, 2010.
4. Paul J. Fortier and Howard E. Michel, "Computer Systems Performance Evaluation and Prediction", Elsevier, 2003.
5. David J. Lilja, "Measuring Computer Performance: A Practitioner's Guide", Cambridge University Press, 2000.
6. Krishna Kant, "Introduction to Computer System Performance Evaluation", McGraw-Hill, 1992.
7. K. S. Trivedi, "Probability and Statistics with Reliability, Queueing and Computer Science Applications", John Wiley and Sons, 2001.