**PROGRAM OBJECTIVES:**

- To introduce the characteristics, basic concepts and systems issues in mobile and pervasive computing
- To illustrate architecture and protocols in pervasive computing and to identify the trends and latest development of the technologies in the area
- To give practical experience in the area through the design and execution of a modest research project
- To design successful mobile and pervasive computing applications and services
- To evaluate critical design tradeoffs associated with different mobile technologies, architectures, interfaces and business models and how they impact the usability, security, privacy and commercial viability of mobile and pervasive computing services and applications

**PROGRAM OUTCOME:**

- To discover the characteristics of pervasive computing applications including the major system components and architectures of the systems
- To analyze the strengths and limitations of the tools and devices for development of pervasive computing systems
- To explore the characteristics of different types of mobile networks on the performance of a pervasive computing system
- To analyze and compare the performance of different data dissemination techniques and algorithms for mobile real-time applications
- To develop an attitude to propose solutions with comparisons for problems related to pervasive computing system through investigation

**AFFILIATED INSTITUTIONS**

**ANNA UNIVERSITY, CHENNAI 600 025**

**REGULATIONS - 2013**

**M.E. MOBILE AND PERVASIVE COMPUTING**

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

## SEMESTER I

| SL.NO | CODE NO. | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| **THEORY** | | | | | | |
| 1. | MA7156 | Applied Mathematics for Pervasive Computing | 3 | 1 | 0 | 4 |
| 2. | MP7101 | Pervasive Computing | 3 | 0 | 0 | 3 |
| 3. | MP7102 | Embedded and Real Time Systems | 3 | 0 | 0 | 3 |
| 4. | CU7201 | Wireless Communication Networks | 3 | 0 | 0 | 3 |
| 5. | CP7204 | Advanced Operating Systems | 3 | 0 | 0 | 3 |
| 6. | MP7103 | Mobile Computing | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | | |
| 7. | MP7111 | Embedded Systems Laboratory | 0 | 0 | 3 | 2 |
| 8. | MP7112 | Wireless Networking Laboratory | 0 | 0 | 3 | 2 |
| | | **TOTAL** | **18** | **1** | **6** | **23** |

## SEMESTER II

| SL.NO | CODE NO. | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| **THEORY** | | | | | | |
| 1. | MP7201 | Ad hoc and Wireless Sensor Networks | 3 | 0 | 0 | 3 |
| 2. | AP7101 | Advanced Digital Signal Processing | 3 | 1 | 0 | 4 |
| 3. | MP7202 | Security for Distributed Systems | 3 | 0 | 0 | 3 |
| 4. | MP7203 | Software Technologies for Pervasive Computing | 3 | 0 | 0 | 3 |
| 5. | | Elective I | 3 | 0 | 0 | 3 |
| 6. | | Elective II | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | | |
| 7. | MP7211 | Pervasive Computing Laboratory | 0 | 0 | 3 | 2 |
| 8. | MP7212 | RFID and Sensor Networks Laboratory | 0 | 0 | 3 | 2 |
| | | **TOTAL** | **18** | **1** | **6** | **23** |

**SEMESTER III**

| SL.No | CODE NO. | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| **THEORY** | | | | | | |
| 1. | MP7301 | Context Aware Computing | 3 | 0 | 0 | 3 |
| 2. | | Elective III | 3 | 0 | 0 | 3 |
| 3. | | Elective IV | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | | |
| 4. | MP7311 | Project Work ( Phase I) | 0 | 0 | 12 | 6 |
| | | **TOTAL** | **9** | **0** | **12** | **15** |

**SEMESTER IV**

| SL.No | CODE NO. | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| **PRACTICAL** | | | | | | |
| 1. | MP7411 | Project Work (Phase II) | 0 | 0 | 24 | 12 |
| | | **TOTAL** | **0** | **0** | **24** | **12** |

**TOTAL NO. OF CREDITS:73**

## LIST OF ELECTIVES

### ELECTIVE – I

| SL.NO | CODE NO. | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| **THEORY** | | | | | | |
| 1. | MP7001 | XML and Web Services | 3 | 0 | 0 | 3 |
| 2. | MU7004 | Service Oriented Architecture | 3 | 0 | 0 | 3 |
| 3. | IF7203 | Data Warehousing and Data Mining | 3 | 0 | 0 | 3 |
| 4. | MP7002 | Human Computer Interaction | 3 | 0 | 0 | 3 |

### ELECTIVE – II

| SL.NO | CODE NO. | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| **THEORY** | | | | | | |
| 5. | MP7003 | RFID and Applications | 3 | 0 | 0 | 3 |
| 6. | MU7202 | Image Processing and Pattern Recognition | 3 | 0 | 0 | 3 |
| 7. | MP7004 | Fault Tolerant Computing | 3 | 0 | 0 | 3 |
| 8. | IF7013 | Energy Aware Computing | 3 | 0 | 0 | 3 |

### ELECTIVE – III

| SL.No | CODE NO. | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| **THEORY** | | | | | | |
| 9. | IF7301 | Soft Computing | 3 | 0 | 0 | 3 |
| 10. | SE7003 | Machine learning | 3 | 0 | 0 | 3 |
| 11. | MP7005 | Autonomous Computing | 3 | 0 | 0 | 3 |
| 12. | MP7006 | Haptic Technology | 3 | 0 | 0 | 3 |

### ELECTIVE – IV

| SL.No | CODE NO. | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| **THEORY** | | | | | | |
| 13. | IF7202 | Cloud Computing | 3 | 0 | 0 | 3 |
| 14. | IF7002 | Bio Informatics | 3 | 0 | 0 | 3 |
| 15. | MP7007 | Nano Computing | 3 | 0 | 0 | 3 |
| 16. | MP7008 | Semantic Web | 3 | 0 | 0 | 3 |

**MA7156 APPLIED MATHEMATICS FOR PERVASIVE COMPUTING L T P C**
**3 1 0 4**

**OBJECTIVES:**

- To understand mathematical concepts for Pervasive Computing system analysis
- To become familiar with graph theory for modelling the networks
- To understand various optimization techniques for utilising system and network resources.
- To understand the Probability and Queuing theories to address stochastic and dynamic environment in data transfer.

**UNIT I LINEAR ALGEBRA 9**

Introduction to Vector spaces, basic vector analysis methods, Matrix norms – Jordan canonical form – Generalized eigenvectors – Singular value decomposition – Pseudo inverse – Least square approximations – QR algorithm.

**UNIT II GRAPH THEORY 9**

Introduction to Paths, Trees, Vector spaces, Matrix Coloring and directed graphs; Some basic algorithms – Shortest path algorithms – Depth-First search on a graph – Isomorphism – Other Graph - Theoretic algorithms – performance of graph theoretic algorithms – Graph-theoretic Computer languages

**UNIT III OPTIMIZATION TECHNIQUES 9**

Linear programming - Basic concepts – Graphical and Simplex methods –Transportation problem – Assignment problem; Dynamic programming - Elements of the dynamic programming model – optimality principle – Examples of dynamic programming models and their solutions.

**UNIT IV PROBABILITY AND RANDOM VARIABLES 9**

Probability – 1D Random variables – Binomial, Poisson, Geometric, Uniform, Normal, Exponential distributions – Moment generating functions and their properties – Functions Transformation of Random variables, Finite probability - Probability distributions – Conditional Probability – Independence – Baye's theorem; Expectations. Reliability and Markov chain transition probability matrix.

**UNIT V QUEUEING THEORY 9**

Single and Multiple servers Markovian Queuing models, finite and Infinite capacity Queues – Finite source model – Queuing applications.

**L : 45 T : 15 TOTAL : 60 PERIODS**

**OUTCOMES:**

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

- Be able to theoretically analyse the Pervasive Computing system.
- Model the networks using graph theory.
- Utilise the system and network resources using various optimization techniques.
- Address stochastic and dynamic behaviour of data transfer using Probability and Queuing theories.

**REFERENCES:**

1. Taha H .A., Operations Research: An Introduction, Pearson Education Edition, Asia, New Delhi, Seventh Edition 2002.
2. Walpole R.E., Myer R.H., Myer S.L., and Ye, K., Probability and Statistics for Engineers and Scientists, Pearson Education, 7th Edition, Delhi, 2002.

3. Lewis.D.W. “Matrix Theory” , Allied Publishers, Chennai 1995
4. Bronson, “Matrix Operations, Schaums outline Series”, McGraw Hill, New York. 1989.
5. Kishor S.Trivedi, Probability & Statistics with reliability, queuing and Computer Science Applications, Prentice Hall India, 2001
6. Narasingh Deo,Graph Theory with applications to Engineering and Computer Science, Prentice Hall India,1997
7. Harary, Graph Theory, Narosa publishing house - 2000

**MP7101 PERVASIVE COMPUTING L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To understand the characteristics and principles of Pervasive computing and the solutions that are in use
- To realize the role of wireless protocols in shaping the future Internet
- To design and implement pervasive applications
- To give an introduction to the enabling technologies of pervasive computing

**OUTCOMES**:

Upon the completion of this course given in the curriculum, students should be able to

- Outline the basic problems, performance requirements of pervasive computing applications, and the trends of pervasive computing and its impacts on future computing applications and society
- analyze and compare the performance of different data dissemination techniques and algorithms for mobile real-time applications
- analyze the performance of different sensor data management and routing algorithms for sensor networks
- develop an attitude to propose solutions with comparisons for problems related to pervasive computing system through investigation

**UNIT I INTRODUCTION 9**

Pervasive Computing- Principles, Characteristics- interaction transparency, context aware, automated experience capture. Architecture for pervasive computing- Pervasive devices-embedded controls.- smart sensors and actuators -Context communication and access services

**UNIT II PROTOCOLS 9**

Open protocols- Service discovery technologies- SDP, Jini, SLP, UpnP protocols–data synchronization- SyncML framework - Context aware mobile services - Context aware sensor networks, addressing and communications- Context aware security.

**UNIT III TECHNOLOGIES 9**

Past, Present and Future-Device Technology-Device Connectivity-Web application Concepts-WAP and Beyond-Voice Technologies-Personal Digital Assistants

**UNIT IV ARCHITECTURE** **9**

Server side programming in Java-Pervasive Web application Architecture-Example Application-Access via PCs-Access via WAP-Access via PDA and Voice

**UNIT V EXAMPLES** **9**

Smart Tokens, Heating Ventilation and Air Conditioning, Set Top Boxes, Appliances and Home Networking, Residential Gateway, Automotive Computing, On Board Computing Systems, In Vehicle networks, Entertainment Systems

**TOTAL: 45 PERIODS**

**REFERENCES:**


1. Seng Loke, Context-Aware Computing Pervasive Systems, Auerbach Pub., New York, 2007.
2. Uwe Hansmann etl , Pervasive Computing, Springer, New York,2001.
3. Jochen Burkhardt, , Stefan Hepper, Klaus Rindtorff, Thomas Schaeck ”Pervasive Computing-Technology and Architecture of Mobile Internet Application”,Pearson Education,sixth Edition 2009.


**MP7102 EMBEDDED AND REAL TIME SYSTEMS** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

To provide exposure to Embedded processors and knowledge on Microcontroller programming and Real time operating system features, to enable design of embedded systems.

**UNIT I EMBEDDED COMPUTING** **9**

Challenges of Embedded Systems – Embedded system design process- Embedded processors – ARM processor – Architecture, ARM and Thumb Instruction sets -Introduction, 8051 Micro controller Hardware - Input/Output Ports and Circuits - External Memory, Counter and Timers, Serial data Input/Output, Interrupts.

**UNIT II EMBEDDED PROGRAMMING** **9**

Basic Assembly Language Programming Concept -The Assembly Language Programming Process - Programming Tools and Techniques- Programming the 8051- Data Transfer and Logical Instructions - Arithmetic Operations, Decimal Arithmetic- Jump and Call Instructions - Further Details on Interrupts.

**UNIT III EMBEDDED DESIGN** **9**

Profiling and cycle counting – instruction scheduling – Register allocation – conditional execution – looping constructs – bit manipulation – efficient switches – optimized primitives.

**UNIT IV REAL TIME SYSTEMS** **9**

Introduction to Real – Time Operating Systems - Tasks and Task States- Tasks and Data, Semaphores, and Shared Data- Message Queues, Mailboxes and Pipes, Timer Functions, Events, Memory management -Interrupt Routines in an RTOS Environment.

**UNIT V EMBEDDED SOFTWARE 9**

Meeting real time constraints – Multi-state systems and function sequences. Embedded software development tools – Emulators and debuggers. Design methodologies – Case studies – Complete design of example embedded systems.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**THE STUDENTS WILL BE ABLE TO**

- design an embedded system
- acquire microcontroller assembly language programming skills
- gain knowledge in debugging and verification using a simulator and on microcontrollers
- make use of embedded software tools
- understand the importance of real time system operating systems

**REFERENCES:**


1. Frank Vahid, Tony Givargis, “Embedded System Design”, John Wiley & Sons, 2009.
2. Raj Kamal, “Embedded Systems”, Tata McGraw-Hill, 2008.
3. Ajay V Deshmukhi, “Micro Controllers – Theory and Applications”, Tata McGraw-Hill, 2005.
4. Raj Kamal, **“**Microcontrollers: Architecture, Programming, Interfacing And System Design**”,** Pearson Education India, 2009.
5. David E. Simon, “An Embedded Software Primer”, Pearson Education, 1999.


**CU7201 WIRELESS COMMUNICATION NETWORKS L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the concepts of wireless communication.
- To make the students to know about the various propagation methods, Channel models, capacity calculations multiple antennas and multiple user techniques used in the mobile communication.
- To enhance the understanding of Wi-fi, 3G systems and 4G networks.

**UNIT I WIRELESS CHANNEL PROPAGATION AND MODEL 9**

Propagation of EM signals in wireless channel – Reflection, diffraction and Scattering-Small scale fading- channel classification- channel models – COST -231 Hata model, Longley-Rice Model, NLOS Multipath Fading Models: Rayleigh, Rician, Nakagami, Composite Fading –shadowing Distributions, Link power budget Analysis.

**UNIT II DIVERSITY 9**

Capacity of flat and frequency selective fading channels-Realization of independent fading paths, Receiver Diversity: selection combining, Threshold Combining, Maximum-ratio Combining, Equal gain Combining. Transmitter Diversity: Channel known at transmitter, channel unknown at the transmitter.

**UNIT III MIMO COMMUNICATIONS 9**

Narrowband MIMO model, Parallel decomposition of the MIMO channel, MIMO channel capacity, MIMO Diversity Gain:Beamforming, Diversity-Multiplexing trade-offs, Space time Modulation and coding : STBC,STTC, Spacial Multiplexing and BLAST Architectures.

**UNIT IV MULTI USER SYSTEMS 9**

Multiple Access : FDMA,TDMA, CDMA,SDMA, Hybrid techniques, Random Access: ALOHA,SALOHA,CSMA, Scheduling, power control, uplink downlink channel capacity, multiuser diversity, MIMO-MU systems.

**UNIT V WIRELESS NETWORKS 9**

3G Overview, Migration path to UMTS, UMTS Basics, Air Interface, 3GPP Network Architecture, 4G features and challenges, Technology path, IMS Architecture - Introduction to wireless LANs - IEEE 802.11 WLANs - Physical Layer- MAC sublayer.

**TOTAL: 45 PERIODS**

**REFERENCES:**


1. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.
2. HARRY R. ANDERSON, "Fixed Broadband Wireless System Design" John Wiley – India, 2003.
3. Andreas.F. Molisch, "Wireless Communications", John Wiley – India, 2006.
4. Simon Haykin & Michael Moher, "Modern Wireless Communications", Pearson Education, 2007.
5. Rappaport. T.S., "Wireless communications", Pearson Education, 2003.
6. Clint Smith. P.E., and Daniel Collins, "3G Wireless Networks", 2nd Edition, Tata McGraw Hill, 2007.
7. Vijay. K. Garg, "Wireless Communication and Networking", Morgan Kaufmann Publishers, http://books.elsevier.com/9780123735805:, 2007.
8. Kaveth Pahlavan,. K. Prashanth Krishnamuorthy, "Principles of Wireless Networks", Prentice Hall of India, 2006.
9. William Stallings, "Wireless Communications and networks" Pearson / Prentice Hall of India, 2nd Ed., 2007.
10. Sumit Kasera and Nishit Narang, "3G Networks – Architecture, Protocols and Procedures", Tata McGraw Hill, 2007.


**OUTCOMES:**

- The students understand the state of art techniques in wireless communication.
- Students are enriched with the knowledge of present day technologies to enable them to face the world and contribute back as researchers.

**CP7204 ADVANCED OPERATING SYSTEMS L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To learn the fundamentals of Operating Systems
- To gain knowledge on Distributed operating system concepts that includes architecture, Mutual exclusion algorithms, Deadlock detection algorithms and agreement protocols
- To gain insight on to the distributed resource management components viz. the algorithms for implementation of distributed shared memory, recovery and commit protocols
- To know the components and management aspects of Real time, Mobile operating systems

**UNIT I FUNDAMENTALS OF OPERATING SYSTEMS 9**

Overview – Synchronization Mechanisms – Processes and Threads - Process Scheduling – Deadlocks: Detection, Prevention and Recovery – Models of Resources – Memory Management Techniques.

**UNIT II DISTRIBUTED OPERATING SYSTEMS 9**

Issues in Distributed Operating System – Architecture – Communication Primitives – Lamport's Logical clocks – Causal Ordering of Messages – Distributed Mutual Exclusion Algorithms – Centralized and Distributed Deadlock Detection Algorithms – Agreement Protocols.

**UNIT III DISTRIBUTED RESOURCE MANAGEMENT 9**

Distributed File Systems – Design Issues - Distributed Shared Memory – Algorithms for Implementing Distributed Shared memory–Issues in Load Distributing – Scheduling Algorithms – Synchronous and Asynchronous Check Pointing and Recovery – Fault Tolerance – Two-Phase Commit Protocol – Nonblocking Commit Protocol – Security and Protection.

**UNIT IV REAL TIME AND MOBILE OPERATING SYSTEMS 9**

Basic Model of Real Time Systems - Characteristics- Applications of Real Time Systems – Real Time Task Scheduling - Handling Resource Sharing - Mobile Operating Systems –Micro Kernel Design - Client Server Resource Access – Processes and Threads - Memory Management - File system.

**UNIT V CASE STUDIES 9**

Linux System: Design Principles - Kernel Modules - Process Management Scheduling - Memory Management - Input-Output Management - File System - Interprocess Communication. iOS and Android: Architecture and SDK Framework - Media Layer - Services Layer - Core OS Layer - File System.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

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

- Discuss the various synchronization, scheduling and memory management issues
- Demonstrate the Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating system
- Discuss the various resource management techniques for distributed systems
- Identify the different features of real time and mobile operating systems
- Install and use available open source kernel
- Modify existing open source kernels in terms of functionality or features used

**REFERENCES:**


1. Mukesh Singhal and Niranjan G. Shivaratri, "Advanced Concepts in Operating Systems – Distributed, Database, and Multiprocessor Operating Systems", Tata McGraw-Hill, 2001.
2. Abraham Silberschatz; Peter Baer Galvin; Greg Gagne, "Operating System Concepts", Seventh Edition, John Wiley & Sons, 2004.
3. Daniel P Bovet and Marco Cesati, "Understanding the Linux kernel", 3rd edition, O'Reilly, 2005.
4. Rajib Mall, "Real-Time Systems: Theory and Practice", Pearson Education India, 2006.
5. Neil Smyth, "iPhone iOS 4 Development Essentials – Xcode", Fourth Edition, Payload media, 2011.

**MP7103** **MOBILE COMPUTING** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To understand the challenges of wireless communication and the solutions that are in use.
- To study about various types of wireless data networks and wireless voice networks
- To realize the role of wireless protocols in shaping the future Internet.
- To design and implement mobile applications.
- To give an introduction to the enabling technologies of pervasive computing.

**OUTCOMES**:

Upon the completion of this course given in the curriculum, students should be able to

- Demonstrate the actual meaning of power and energy management in wireless mobile networks.
- Outline knowledge on Mobile IP.
- Analyze and characterize Location management in wireless mobile networks.

**UNIT I INTRODUCTION** **10**

History – Wireless communications: GSM – DECT – TETRA – UMTS – IMT – 2000 – Blue tooth, WiFi, WiMAX, 3G ,WATM.- Mobile IP protocols -WAP push architecture-Wml scripts and applications. Data networks – SMS – GPRS – EDGE – Hybrid Wireless100 Networks – ATM – Wireless ATM.

**UNIT II MOBILE LAYERS** **9**

Mobile IP: Goals – Assumptions and Requirement – Entities – IP packet delivery – Agent advertisement and discovery – IPV6 – DHCP-Traditional TCP – Indirect TCP – Snooping TCP – Mobile TCP – Fast retransmit/Fast Recovery – Transmission/Timeout Freezing – Selective Retransmission – Transaction Oriented TCP

**UNIT III ARCHITECTURE** **9**

Mobile computing environment—functions-architecture-design considerations, content architecture - CC/PP exchange protocol ,context manager. Data management in WAE Coda file system- caching schemes- Mobility QOS- Security in mobile computing.

**UNIT IV LOCATION MANAGEMENT** **9**

Handoff in wireless mobile networks-reference model-handoff schemes. Location management in cellular networks - Mobility models- location and tracking management schemes- time, movement ,profile and distance based update strategies. ALI technologies

**UNIT V PLATFORMS AND RECENT TRENDS** **8**

Network simulators: NS2 – GLOMOSIM – SENSIM – OPNET – Programming Platforms – J2ME – SYMBIAN OS – Recent advances in Wireless Networks.

**TOTAL: 45 PERIODS**

**REFERENCES:**

1. J.Schiller, “Mobile Communication”, Addison Wesley, 2000.
2 .Ivan Stojmenovic , Handbook of Wireless Networks and Mobile Computing, John Wiley & sons Inc, Canada, 2002.
3. Asoke K Taukder,Roopa R Yavagal, Mobile Computing, Tata McGraw Hill Pub Co. , New Delhi, 2005.
4. William Stallings, “Wireless Communication and Networks”, Pearson Education, 2003.

**MP7111** **EMBEDDED SYSTEMS LABORATORY** **L T P C**
**0 0 3 2**

**OBJECTIVE:**
Objective of the Embedded Lab is to analyze and design various Microcontroller applications and RTOS Characteristics.

**PREREQUISITES**
Essential Knowledge in Microprocessor, Micro controllers and DSP.

**Optional**
Knowledge of Operating Systems ,C and C++

**Lab Exercise**

**Case Study 1:**There is a wide offer of microcontroller of 4,8,16/32 bits. It has traditional architecture, an EEPROM memory and flexible timers/counters very useful to apply in a great quantity problem.

**I Basic programming of micro controllers**
Study of the architecture and instruction set of popular micro controllers
(8 bit, 16 bit, 32 bit processors)
1. Assembler and Embedded Programming
2. High level language programming (C, C++) and porting it on a processor
**Case Study 2:** Case of various interfacing projects: Digital tape measure using ultrasonic transducer, serial communication using infrared transceiver, volt-meter, home security system etc.

**II. Interfacing experiments using microcontrollers**
1. Using interrupts and interfacing clocks.
2. Interfacing peripheral devices / IO.
3. Motor speed control.

**Case Study 3:** Embedded Programming on PIC microcontrollers using C/ASM: Number system,operators, decisions, pointers/arrays, memory/register access. Real-time programming model: interrupts,multitasking (scheduling, concurrency)

**III. RTOS Experiments**
1. Introduction to Real-Time /Embedded Operating Systems.
2. Process Management & Inter Process Communication
3. Memory management
4. I/O subsystem
5. Real Time Scheduling

**Case Study 4:** DSP experiments provide powerful and flexible cache architecture suitable for soft real-time control tasks and industry-standard operating systems, plus hard real-time signal processing. Full SIMD architecture, including instructions for accelerated video and image processing

**IV. DSP Experiments (Either in TMS or in ADSP processor)**
1. Implementation of multirate sampling systems
2. Periodogram estimation
3. Adaptive filter implementation
4. Implementation of QMF

**Case Study 5: Configurable Hardware Accelerators for Embedded Systems –** Today's consumer market is driven by technology innovations. Many technologies that were not available a few years ago are quickly being adopted into common use.

**V. Mini Project**

**TOTAL: 45 PERIODS**

**MP7112 WIRELESS NETWORKING LABORATORY L T P C**
**0 0 3 2**

**OBJECTIVES:**

Objective of the Lab is to analyze and design the operation and performance of wireless protocols, capture most recent development in wireless mobile systems in both infrastructure and infrastuctureless scenario.

**PREREQUISITES**

Knowledge in Networking, mobile communication, Computer hardware and software. Knowledge of Ad hoc networks and mobile computing.

**Lab Exercise**

**Case Study 1:**
**Unicast Routing Protocol**

The objective of this case study is to know the types and working procedures of unicast routing protocols in MANET. The concept behind this case study is find the best route in MANET using the following types of routing protocols; table-driven (e.g., link state or DSDV), on-demand (e.g., DSR, AODV, TORA), hybrid (e.g., ZRP, contact-based architectures), hierarchical (e.g., cluster based and landmark-based) and geographic (e.g., greedy routing, GPSR) routing. The efficient path/route should be established for source and destination data transmission using routing protocols. Understand the advantages and disadvantages of each routing protocol types by observe the performance metrics of the routing protocol. In that way the best application/environment suitable routing protocol can be identified.

**Case Study 2:**
**Multicast Routing Protocol**

Multicast routing protocols play an important role in group communication in MANET where the multicast is better than multiple unicast with respect to premium bandwidth utilization. The aim of this case study is to know the difference of unicast and multicast routing protocols working procedures in wireless ad hoc environment. The multicast session nodes are connecting through either tree (MAODV, MCEDAR) or mesh (ODMRP, CAMP, FGMP) structure. In the tree based approach, how to maintain the tree concept like source-tree-based or shared-tree-based is also studied. Understand the initialization of multicast session such as source or receiver initiator also identified. Analyze the performance metrics of multicast routing protocols with unicast routing protocols.

**Case Study 3:**
**Broadcast**

In MANET, broadcast is a methodology to efficiently deliver data and control packets from one node to all other nodes in the network. Broadcasting is necessary for both unicast and multicast routing protocols. Flooding is also used to transmit the packet as a simple form of broadcasting. The disadvantage of broadcasting is congestion and resource wastage. These problems are solved by

various efficient broadcast techniques such as naïve flooding, heuristics (e.g., probabilistic, counter based) and Minimum dominating sets (e.g., MPR multi-point relays, CEDAR). These techniques minimize the number of retransmission while ensures packet is delivered to all the nodes receive in the network. This case study test the broadcast routing under various conditions such as increasing neighbor density, traffic rate and node mobility.

**Case Study 4:**
**Resource Discovery and Rendezvous Routing Protocol**
Resource discovery routing protocol used for very large scale network and may span into wide geographical regions. Contact based routing discovers resource s located beyond the neighborhood. Create a small world using contacts for making efficient query to search the resources. Use contact assisted protocols such as MARQ, CARD and PARSE to efficiently discover resources by selecting contacts. Protocols analyzed in terms of reachability and overhead. And compare these protocols with flooding and unicast routing. Using Rendezvous routing find the intersect points among regions to efficiently search the resources.

**Case Study 5:**
**Wireless MAC Protocols**
MAC protocol used to share limited available bandwidth among all nodes. Fair share and coordination of bandwidth is the key functions of MAC in wireless environment. Send the packet without any contention through wireless link using the following MAC protocols; (CSMA/CA (802.11), MACA, MACAW, PAMAS, SMAC). Analyze its performance with increasing node density and mobility.

**Case Study 6:**
**TCP**
TCP was designed and tuned to work well on networks where loses are mainly congestion losses. The performance of TCP decreases dramatically when a TCP connection traverses a wireless link on which packets may be lost due to wireless transmission errors. Active Queue Management can be used to control congestion on wireless networks. Evaluate the performance of FIFO, RED and WFQ over wireless networks.

**Case Study 7:**
**Physical and MAC Layer of Wireless Links**
This case study should analyze the physical layer and MAC layer features of wireless link by measuring signal strength, data rate, retransmission and delay. The physical layer functions include the selection of frequency band for transmission, detection and estimation of transmitted bits, modulation of incoming bit streams followed by demodulation at receiver and encryption and decryption techniques for data transmission. The MAC layer is responsible to achieve local point-to-point and broadcast communication. Also error detection and error correction in wireless communication are performed using bit stuffing and cyclic redundancy check computation.

**Case Study 8:**
**Mobility Model**
Simulate MANET environment using GloMoSim/NS2 and tested with various mobility model such as Random way point, group mobility, highway model, Manhattan model,hybrid models) (Spatial correlation, temporal correlation, relative speed, link durations). Analyze throughput, PDR and delay with respect to different mobility model of the node.

**Case Study 9:**
**Analyze WLAN Parameters**
This case study analyzes WLAN performance by measuring signal-to-noise ratio, overall throughput, delay and packet delivery ratio with respect to node density, mobility pattern and traffic rate.

**Case Study 10:**
**BlueTooth**
Form a Piconet by connecting mobile nodes that are located within a short range of transmission. Then form a scatternet by connecting all Piconets. Using multihop transmission mobility issues and rate of transmission is to be determined.

**TOTAL : 45 PERIODS**

**MP7201 AD HOC AND WIRELESS SENSOR NETWORKS L T P C**
**3 0 0 3**

**OBJECTIVES:**

To highlight the features of different technologies involved in Ad hoc and Sensor Networking and their performance.

- Students will get an Introduction about Blue tooth and WPAN.
- To study the construction and working of Directional Antennas
- To study the Architecture of Middleware of WSN.
- To know concepts of Location tracking and Infrastructure establishment.
- Enable the students to know techniques involved to support sink mobility and network management

**UNIT I WIRELESS PAN 9**
Introduction – Bluetooth Technology – Enhancements to Bluetooth – The IEEE 802.5 working group for WPANs – Comparison between WPAN systems

**UNIT II DIRECTIONAL ANTENNA 9**
Introduction – Antenna concepts – Evolution of Directional Antenna Systems – Advantages of using Directional Antenna - Directional Antenna for Ad hoc network – Protocol issue on the use of Directional Antenna - Broadcasting – MAC – Routing.

**UNIT III MIDDLEWARE FOR WSN 9**
Introduction – WSN Middleware Principles – Middleware Architecture – Existing Middleware : MiLAN – IrisNet – AMF – DSWare – CLMF – MSM – DDS.

**UNIT IV LOCALIZATION TRACKING AND INFRASTRUCTURE ESTABLISHMENT 9**
A Tracking Scenario – Problem formulation - Distributed representation and inference of states – Tracking multiple objects – Sensor models – Topology control – Clustering – Time synchronization – Localization and Localization Services

**UNIT V SINK MOBILITY AND NETWORK MANAGEMENT IN WSN 9**

Introduction – Energy hole problem – energy efficiency by sink mobility – Sink mobility in Delay – Tolerant Networks – Sink mobility in Real- Time Network – Network Management Requirements – Network Management Design Issues – Management Architecture –MANNA–other issues related to Network management.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon Completion of the course, the students will be able

- To design the basic elements in WPAN.
- To construct Directional Antenna
- To analyze the middleware available for WSN
- To Know methods in Localization tracking and Infrastructure establishment
- To know the concepts in sink mobility and network management in WSN.

**REFERENCES:**


1. Carlos de Morais Cordeiro , Dharma Prakash Agarwal, Ad hoc and Sensor Network : Theory and Applications , 2ND Edition, World Scientific Publishing Co
2. Kazem Sohraby, Daniel Minoli, Taieb Znati , Wireless Sensor Networks: Technology, Protocols and Applications, Wiley Interscience A John Wiley & sons, Inc., Publication .
3. Feng Zhao, Leonidas Guibas, " Wireless Sensor Networks : An information processing Approach " , Elsevier 2004 .
4. Amiya Nayak, Ivan Stojmenovic, : Wireless Sensor and Actuator Networks : Algorithm and Protocols for Scalable Coordination and Data communication John Wiley & Sons 2010 .
5. C.Siva Ram Murthy and B.Smanoj, " Ad Hoc Wireless Networks – Architectures and Protocols", Pearson Education, 2004.
6. Feng Zhao and Leonidas Guibas, "Wireless Sensor Networks", Morgan Kaufman Publishers, 2004.
7. C.K.Toh, "Ad Hoc Mobile Wireless Networks", Pearson Education, 2002.
8. Thomas Krag and Sebastin Buettrich, "Wireless Mesh Networking", O'Reilly Publishers,2007.


**AP7101 ADVANCED DIGITAL SIGNAL PROCESSING L T P C**
**3 1 0 4**

**OBJECTIVES:**

The purpose of this course is to provide in-depth treatment on methods and techniques in

- discrete-time signal transforms, digital filter design, optimal filtering
- power spectrum estimation, multi-rate digital signal processing
- DSP architectures which are of importance in the areas of signal processing, control and communications.

**OUTCOMES:**

Students should be able to:

- To design adaptive filters for a given application
- To design multirate DSP systems.

**UNIT I DISCRETE RANDOM SIGNAL PROCESSING 9**

Weiner Khitchine relation - Power spectral density – filtering random process, Spectral Factorization Theorem, special types of random process – Signal modeling-Least Squares method, Pade approximation, Prony's method, iterative Prefiltering, Finite Data records, Stochastic Models.

**UNIT II SPECTRUM ESTIMATION 9**

Non-Parametric methods - Correlation method - Co-variance estimator - Performance analysis of estimators – Unbiased consistent estimators - Periodogram estimator - Barlett spectrum estimation - Welch estimation - Model based approach - AR, MA, ARMA Signal modeling - Parameter estimation using Yule-Walker method.

**UNIT III LINEAR ESTIMATION AND PREDICTION 9**

Maximum likelihood criterion - Efficiency of estimator - Least mean squared error criterion - Wiener filter - Discrete Wiener Hoff equations - Recursive estimators - Kalman filter - Linear prediction, Prediction error - Whitening filter, Inverse filter - Levinson recursion, Lattice realization, Levinson recursion algorithm for solving Toeplitz system of equations.

**UNIT IV ADAPTIVE FILTERS 9**

FIR Adaptive filters - Newton's steepest descent method - Adaptive filters based on steepest descent method - Widrow Hoff LMS Adaptive algorithm - Adaptive channel equalization - Adaptive echo canceller - Adaptive noise cancellation - RLS Adaptive filters - Exponentially weighted RLS - Sliding window RLS - Simplified IIR LMS Adaptive filter.

**UNIT V MULTIRATE DIGITAL SIGNAL PROCESSING 9**

Mathematical description of change of sampling rate - Interpolation and Decimation - Continuous time model - Direct digital domain approach - Decimation by integer factor - Interpolation by an integer factor - Single and multistage realization - Poly phase realization - Applications to sub band coding - Wavelet transform and filter bank implementation of wavelet expansion of signals.

**L +T= 45+15, TOTAL: 60 PERIODS**

**REFERENCES:**


1. Monson H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons Inc., New York, 2006.
2. Sophoncles J. Orfanidis, "Optimum Signal Processing ", McGraw-Hill, 2000.
3. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Prentice Hall of India, New Delhi, 2005.
4. Simon Haykin, "Adaptive Filter Theory", Prentice Hall, Englehood Cliffs, NJ1986.
5. S. Kay," Modern spectrum Estimation theory and application", Prentice Hall, Englehood Cliffs, NJ1988.
6. P. P. Vaidyanathan, "Multirate Systems and Filter Banks", Prentice Hall, 1992.

**MP7202 SECURITY FOR DISTRIBUTED SYSTEMS L T P C**
**3 0 0 3**

**OBJECTIVES:**

This subject presents a comprehensive treatment on security issues in Peer to Peer Network, Distributed systems, Internet, Wireless network, Mobile and pervasive computing.

- To study the security issues in Internet
- To study the security issues in Distributed computing
- To study the security issues in pervasive computing
- To study the security issues in sensor and Ad hoc networks.
- To study the security issues in Wireless networks

**UNIT I SECURITY IN INTERNET 9**

Security issues in TCP/IP Suite – Spam Email – Spyware – Overview of Secure Real Time Transport Protocol.

**UNIT II SECURITY IN DISTRIBUTED COMPUTING 9**

Cover free families – Applications – ID based Hierarchical Key graph Scheme- Multi privileged group communication – Access control policy Negotiation solution.

**UNIT III SECURITY IN PERVASIVE COMPUTING 9**

Security issues in RFID systems – Solutions – Enhancements – performance of 802.15.4 cluster – Key Exchange Protocol – Wireless network interface cards.

**UNIT IV SECURITY IN SENSOR AND AD HOC NETWORKS 9**

Time Synchronization Protocol – Network Attacks-Counter measures –Sensor Key Management techniques – Source Authentication- ID based Authentication-Key exchange scheme-Key Distribution Scheme – ID based online/offline scheme – Authentication in AODV-Multi signature Scheme.

**UNIT V SECURITY IN WIRELESS NETWORKS 9**

Wireless LAN Security Attacks- Security Mechanisms – Authentication-Authorization- Accounting Protocols – Wireless Cellular Network.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon Completion of the course,the students will be able

- To analyze the security issues in Internet
- To analyze security issues and solutions for Distributed Computing
- To analyze security issues in Pervasive computing
- To find the countermeasures for the security issues in Sensor and Adhoc network.
- To analyze the security issues in Wireless networks.

**REFERENCES:**


1. Security in Distributed and Network security, Volume I, Yang Xiao , Yi Pan,2007 World Scientific publications
2. Security Engineering, Ross Anderson, 2nd Edition, John Wiley Publications
3. Distributed systems security-Issues, processes and solutions, Feb 2009, John wiley.
4. Distributed Systems Concepts and Design, George Coulouris, Jean Dollimore, Tim Kindberg, Fifth Edition, Pearson Education Asia, 2012.
5. Distributed Systems, A.S.Tanenbaum, M.Van Steen, Pearson Education.
6. Wireless Sensor and Actuator Networks: Algorithm and Protocols for Scalable Coordination and Data communication. Amiya Nayak , Ivan Stojmenovic, John Wiley & Sons 2010

**MP7203 SOFTWARE TECHNOLOGIES FOR PERVASIVE COMPUTING L T P C**
**3 0 0 3**

**UNIT I ISSUES AND CHALLENGES 9**

Challenges of Concurrent and Networked Software -Service Access and Configuration and other Challenges **–** Mobile Development Process –Architecture – Design and Technology selection for Mobile Applications

**UNIT II APPLICATION AND USER INTERFACE DEVELOPMENT 9**

Introduction to Mobile Development Frameworks and Tools – Fully Centralized Frameworks and Tools – N-Tier Client–Server Frameworks and Tools –JAVA – WINDOWS CE – WAP – Symbian EPOC - Brew OS- Android OS

**UNIT III UML AND USER INTERFACE DEVELOPMENT 9**

Introduction to UML – Class diagrams – Object diagrams – Collaboration diagrams – Sequence diagrams – Activity diagrams – State chart diagrams – Component diagrams – Deployment diagrams – Use case diagrams – Device – Independent and Multi – channel User Interface Development Using UML

**UNIT IV J2ME OVERVIEW 9**

J2ME Overview – J2ME and Wireless Devices – Small Computing technology – Wireless Technology – Radio Data Networks – Microwave Technology – Mobile Radio Networks – J2ME Architecture and Development Environment – Runtime Environment – MIDlet Programming

**UNIT V J2ME USER INTERFACE 9**

J2ME User Interface – Commands, Items and Event Processing – Exception Handling – High – Level Display – Screens – Low Level Display – Canvas – User Interactions – graphics – Clipping Regions – Animations.

**TOTAL: 45 PERIODS**

**REFERENCES:**


1. Reza B'Far, "Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML", Cambridge University Press, 2005.
2. James Keogh, "J2ME: The Complete Reference", Tata McGraw Hill, 2003.
3. Tommi Mikkonen, "Programming mobile devices – An Introduction for practitioners", Wiley, 2007.
4. Douglas Schmidt, Michael Stal, Hans Rohnert and Frank Buschmann, "Pattern – Oriented Software Architecture– Patterns for Concurrent and Networked Objects", John Wiley, 2008
5. James Keogh, "J2ME: The Complete Reference", Tata McGraw Hill, 2003.

| MP7211 | PERVASIVE COMPUTING LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 2 |

**PERVASIVE COMPUTING LABORATORY**

**Course Objectives:**

- To understand and use the fundamentals of programming for mobile devices.
- To apply event-driven programming and graphical user interfaces for mobile devices

**COURSE OUTCOMES**:

Upon the completion of this course given in the curriculum, students should be able to

- To design the software for mobile phones.
- To demonstrate Handheld computing

**LIST OF EXPERIMENTS**

**1. STUDY EXPERIMENT**

To explore overall view about

- Pervasive Computing Architecture
- Communication protocols
- Software infrastructure
- Security mechanisms

**2. STUDY OF MIDDLEWARE, APPLICATION LEVEL, NETWORK, SYSTEM SOFTWARE**

- To design the software for mobile phones using J2ME
- J2ME basics
- User interface design
- Control structures
- Files and databases
- Communication
- Interoperability between Mobile phones

To design the software for mobile phones using SYMBION OS

- Text string handling
- Graphical application
- Dialog application
- Drawing application
- File handling operations

**3. APPLICATION LEVEL**

To study new HCI techniques for small mobile devices and embedded devices.

**4. CASE STUDIES. PROJECTS IN PERVASIVE COMPUTING**

To explore wearable and handheld computing and their enabling technologies

**TOTAL: 45 PERIODS**

**MP7212** **RFID AND SENSOR LABORATORY** **L T P C**
**0 0 3 2**

**LIST OF EXPERIMENTS**

1. Basics of WSN programming using Tiny OS.
2. Sensing data using WSN motes.
3. Simulation of WSN using TOSSIM simulation framework.
4. Topology discovery using distributed algorithms.
5. Integration of mobile nodes with static monitoring sensor nodes (Heterogeneous sensor networks) .
6. Study on cryptographically secured (private key) communication in WSNs.
7. Study of Passive& Active RFID System components.
8. Interfacing RFID Reader with computers using Reader Communication Protocols.
9. Reading a UID from the RFID Tag using TAG Commands and Response format.
10. Reading and Writing data into a particular memory block of the RFID transponder
11. Case Study using ISO 15693 standard 13.56 MHz RFID Reader and Tags:
    (i) Library Management
    (ii) Baggage Handling
    (iii) National Identification
    (i) Mother Baby pairing

    Discuss the present situation , RFID solution ,Advantages of RFID, Actual Implementations, Future Scenarios.

**TOTAL:45 PERIODS**

**MP7301** **CONTEXT AWARE COMPUTING** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

This course will provide in depth knowledge in context awareness and its security issues.

- To understand the basic concepts of Context Awareness.
- To study the concepts in Distributed and Heterogeneous context.
- To understand the principles of Dynamic current negotiation
- To study the concepts of Context aware mobile and pervasive systems
- To know the security issues in Context aware computing

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

Context Awareness – Surrounding Context – Activity on a Street – User Attention in a Meeting- Activity context from multiple sensors – I Badge- Media cup

**UNIT II DISTRIBUTED AND HETEROGENEOUS CONTEXT FOR AMBIENT INTELLIGENCE** **9**

Fundamental Concepts – Ontology Representation and Reasoning about Context – Ontology Alignment Approaches – Campus Approach

**UNIT III DYNAMIC CURRENT NEGOTIATION IN WEB ENVIRONMENTS 9**

Ubiquitous web – System Description – System Deployment – Collaborative Optimizations- Context Acquisition – Provisioning.

**UNIT IV CONTEXT AWARE MOBILE AND PERVASIVE SYSTEMS 9**

Elements of a context aware pervasive system- Architecture- Infrastructure, Middleware, Tool Kits – context for mobile device users – Location based Services – Ambient services – context aware mobile services – Mobile code and policy – Multi agent technology.

**UNIT V CONTEXT AWARE SECURITY 9**

Traditional Security issues – models – context aware security systems – context aware safety.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon Completion of the course, the students will be able

- To familiar with fundamental concepts in Context Aware computing.
- To familiar with Ontology alignment and campus approaches for Distributed Context for Ambient Intelligence.
- To analyze the Context Awareness in Web environment.
- To analyze the Context Awareness in Mobile and Pervasive Systems.
- To analyze the various security issues in Context Aware Computing.

**REFERENCES:**


1. Context aware pervasive systems-Architecture for a new breed of applications Sengloke, Auerbach publications, 2006.
2. Context Aware Computing and Self Managing systems ,Waltenegus Dargie,A chapman & Hall Book/CRC press, 2010
3. Context-Aware Mobile and Ubiquitous Computing for Enhanced Usability**:** Adaptive Technologies and Applications: Dragan Stojanović, IGI Global Snippet, 2009
4. Context Management for Distributed and Dynamic Context-Aware Computing, **Rocha,** Ricardo Couto Antunes da**, Endler,** Markus,Springer,2012.
5. Context-Aware Computing: A Special Triple Issue of Human-Computer Interaction,Thomas P.Moran Paul Dourish,www.Amazon.com,2002.
6. Seeking a Foundation for Context-Aware Computing, Paul Dourish , University of California, Irvine

**MP7001** **XML AND WEB SERVICES** **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.

**MU7004 SERVICE ORIENTED ARCHITECTURE L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To understand various architecture for application development
- To learn the importance of SOA in Application Integration
- To learn web service and SOA related tools

**UNIT I SOA BASICS 9**

Software Architecture – Types of IT Architecture – SOA – Evolution – Key components – perspective of SOA – Enterprise-wide SOA – Architecture – Enterprise Applications – Solution Architecture for enterprise application – Software platforms for enterprise Applications – Patterns for SOA – SOA programming models

**UNIT II SOA ANALYSIS AND DESIGN 9**

Service-oriented Analysis and Design – Design of Activity, Data, Client and business process services – Technologies of SOA – SOAP – WSDL – JAX – WS – XML WS for .NET – Service integration with ESB – Scenario – Business case for SOA – stakeholder OBJECTIVES – benefits of SPA – Cost Savings

**UNIT III SOA GOVERNANCE 9**

SOA implementation and Governance – strategy – SOA development – SOA governance – trends in SOA – event-driven architecture – software s a service – SOA technologies – proof-of-concept – process orchestration – SOA best practices

**UNIT IV SOA IMPLEMENTATION 9**

SOA based integration – integrating existing application – development of web services – Integration - SOA using REST – RESTful services – RESTful services with and without JWS – Role of WSDL,SOAP and Java/XML mapping in SOA – JAXB Data binding.

**UNIT V APPLICATION INTEGRATION 9**

JAX –WS 2.0 client side/server side development – Packaging and Deployment of SOA component – SOA shopper case study –WSDL centric java WS with SOA-J – related software – integration through service composition (BPEL) – case study - current trends.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**Students should be able to work with**

- Comparison of different IT architecture
- Analysis and design of SOA based applications
- Implementation of web service and realization of SOA
- Implementation of RESTful services
- Design and implementation of SOA based Application Integration using BPEL

**REFERENCES:**


1. Shankar Kambhampaly, “Service –Oriented Architecture for Enterprise Applications”,Wiley 2008.
2. Mark D. Hansen, “SOA using Java Web Services”, Practice Hall, 2007.
3. Waseem Roshen, “SOA-Based Enterprise Integration”, Tata McGraw-HILL, 2009.

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

**COURSE 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**

**COURSE 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


**MP7002 HUMAN COMPUTER INTERACTION L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To know how to analyze and consider user’s need in the interaction system
- To understand various interaction design techniques and models
- To understand the theory and framework of HCI
- Understand and analyze the cognitive aspects of human – machine interaction

**UNIT I INTRODUCTION 9**

Foundation – Human – Computer – Interaction – Paradigms – What is HCI – Components – Cognitive Framework – Perception and Representation – Attention and Memory Constraint – Knowledge and Mental Model – Interface Metaphors – Input – Output

**UNIT II DESIGN PROCESS 9**

Interaction Styles – Interaction Design Basics – HCI in the Software Process – Design Rules - Designing Windowing Systems - User Support and On-Line Information - Designing For Collaborative Work and Virtual Environments - Principles and User-Centred Design - Methods for User-Centred Design

**UNIT III IMPLEMENTATION AND EVALUATION PROCESS 9**

Implementation issues – Implementation Support - Evaluation techniques – Universal Design – User Support

**UNIT IV MODELS 9**

Cognitive models – Communication and collaboration models: Models of the system – Models of the System – Modeling Rich Interaction

**UNIT V APPLICATIONS 9**

Socio – organization issues and stakeholder requirements - Ubiquitous Computing - Context – aware User Interfaces - Hypertext, multimedia and the World Wide Web

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

- To develop good design for human machine interaction system
- Analyze the user's need in interaction system
- To design new interaction model to satisfy all types of customers
- Evaluate the usability and effectiveness of various products
- To know how to apply interaction techniques for systems

**REFERENCES:**


1. Dix, Finlay, Abowd and Beale. "Human – Computer Interaction", Second edition, Prentice Hall,1998.
2. J. Preece, Y. Rogers, H. Sharp, D. Benyon, S. Holland and T. Carey. "Human – Computer Interaction", Addison Wesley, 1994.


**MP7003 RFID AND APPLICATIONS L T P C**

**3 0 0 3**

**OBJECTIVES**:

- To develop competency skill in the area of design RFID systems in the context of feasible business or industrial applications.
- To cover from design to database integration to installation and maintenance of RFID systems.

**OUTCOMES**:

Upon the completion of this course given in the curriculum, students should be able to

- Discuss the basic components and applications of RFID systems
- Analyze and characterize RFID reader architectures
- Analyze modulation techniques used in RFID systems
- Apply basic concepts of error correcting coding techniques in RFID systems
- Design and analyze theoretical the tracking scenario and sensing model.

**UNIT I RFID BASICS 9**

Introduction – transponder and reader architecture – types of tags and readers –frequencies of operation – selection criteria for RFID systems – information processingin the transponder and reader – fundamental operating principles – antennas for RFIDs.

**UNIT II RFID CODES STANDARDS AND APPLICATIONS 9**

Frequency ranges and licensing regulations – coding and modulation – data integrity and security in RFID systems – memory and microprocessors for RFID – product codes – standards and regulations – Electronic product code – EPC layout and infrastructure – Supply chain management and other examples of RFID applications – EPC in supply chain.

**UNIT III SENSOR NETWORKS 9**

Introduction to various sensors like Temperature – Humidity – Pressure – Introduction to Sensor networks – motivation – applications – sensors – architectures – and platforms for Wireless sensor networks – Sensor Node Architecture – Sensor Network Architecture – Sample sensor networks applications – Design challenges – Performance metrics

**UNIT IV LOCALIZATION AND TRACKING 9**

A tracking scenario – sensing model – Collaborative localization – Bayes state estimation – distributed representation – Tracking multiple objects – Ranging techniques – Range based localization algorithms – location services

**UNIT V NETWORKING SENSORS AND NETWORK PLATFORMS 9**

MAC for sensor networks – Geographic – Energy – aware routing – Attribute – based routing – Sensor node Hardware (Berkeley Motes) – TinyOS – nesC – Tiny GALS – NS –2–TOSSIM – PIECES.

**TOTAL: 45 PERIODS**

**REFERENCES:**


1. F. Zhao and L. Guibas, “Wireless Sensor Networks”, Morgan Kaufmann, San Francisco, 2004.
2. K.Finkenzeller, “RFID Handbook: Fundamentals and Applications in contact less smart cards and identifications”, John Wiley and sons Ltd, 2003.
3. Sandip Lahiri, “RFID Source Book”, Prentice Hall, 2005.
4. Akshay Tyagi, “RF Devices Handbook Technology Design and Applications”, Anerbach Publications, 2006.
5. Cauligi S. Raghavendra, University of Southern California , Krishna Sivalingam, University of aryland Baltimore County , Taieb M. Znati, University of Pittsburg , “Wireless Sensor Networks” , Springer, August 2005.
6. Holger Karl, Technical University of Berlin , Andreas Willig, University of Potsdam , “Protocols and Architectures for Wireless Sensor Networks”, Wiley, June 2005.
7. IEEE Magazines and Journals.


**MU7202 IMAGE PROCESSING AND PATTERN RECOGNITION 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 know the basic concepts in Image Processing.
- To segment the various types of Images.
- To represent the images in different forms
- To develop algorithms for Pattern Recognition
- To implement the features of Image processing in 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

**MP7004** **FAULT TOLERANT COMPUTING** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To understand the importance of fault tolerance in the design of real world system
- To understand the basic knowledge of principles in fault tolerant computer architecture and computing
- To understand the issues in the reliable system and techniques to model fault
- To emphasize the importance of evaluation of system reliability

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

Fault prevention - Fault tolerance - Anticipated and unanticipated fault - Test generation for digital systems - Combinational logic network - Boolean difference method - Test generation for sequential circuits - Fault simulation.

**UNIT II ERROR MODEL** **9**

General coding schemes - Parity checking code - Arithmetic code - Code for computer memories checking errors in logical operation - Communication coding.

**UNIT III FAULT TOLERANCE** **9**

Coding technique - Fault tolerant and self checking and fail safe circuits - Fault tolerant in combinational and sequential circuits - Synchronous and asynchronous fail safe circuits - Study of quantitative methods for reliability evaluation

**UNIT IV ARCHITECTURE** **9**

Fault tolerant computers - General purpose commercial systems - Fault tolerant multiprocessor and VLSI based communication architecture - Distributed fault tolerant systems

**UNIT V FAULT TOLERANT SOFTWARE** **9**

Design-N-version programming - Recovery block - Acceptance tests - Fault trees -Validation of fault tolerant systems – Security - Fault tolerance in wireless/mobile networks and Internet - Case studies of practical fault tolerant systems

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

- Know how to model the reliable system even in the presence of failures
- Knowledge in relationship between testing and reliability
- Students can able to analyze the requirement of system reliability
- To apply the knowledge learnt from this subject to develop new methods and techniques in specific research areas of fault tolerant computing
- Find wide applicable area of reliable and fault tolerant computing

**REFERENCES:**

1. K.K.Praddan, "Fault Tolerant Computing-Theory and Techniques", Vol.III, Prentice Hall, 1989.
2 . Anderson and Lee, "Fault Tolerant Principles and Practice", PHI, 1989.
3. V.Nelson, "Fault-Tolerant Computing: Fundamental Concepts", Victor P. Nelson, IEEE Computer, July 1990
4. I. Koren and C.M. Krishna, “Fault Tolerant Systems”, Morgan Kaufmann Pub. 2007

**IF7013 ENERGY AWARE COMPUTING L T P C**
**3 0 0 3**

**COURSE 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.


**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


**SE7003 MACHINE LEARNING L T P C**

**3 0 0 3**

**UNIT I INTRODUCTION 9**

Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.

**UNIT II NEURAL NETWORKS AND GENETIC ALGORITHMS 9**

Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning.

**UNIT III BAYESIAN AND COMPUTATIONAL LEARNING 9**

Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle –Bayes Optimal Classifier –Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model.

**UNIT IV INSTANT BASED LEARNING 9**

K-Nearest Neighbour Learning – Locally weighted Regression – Radial Bases Functions – Case Based Learning.

**UNIT V ADVANCED LEARNING 9**

Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning.

**TOTAL: 45 PERIODS**

**REFERENCES:**

1.Tom M. Mitchell, “Machine Learning”, McGraw-Hill edition, 1997

2.Ethem Alpaydin, “Introduction to Machine Learning (Adaptive Computation and Machine Learning)”, The MIT Press 2004

3.T. Hastie, R. Tibshirani, J. H. Friedman, “The Elements of Statistical Learning”, Springer Verlag, 2001

4. Pattern recognition and machine learning by Christopher Bishop, Springer Verlag, 2006.

**MP7005 AUTONOMOUS COMPUTING L T P C**

**3 0 0 3**

**OBJECTIVES:**

- Enable computing systems to operate in a fully autonomous manner without administration
- Know the existing software and hardware systems weakness, untrustworthiness and cost to support autonomous computing system
- Know the evolution software system capable to perform self-modification based on feedback based learning
- Know the importance of evolution of hardware to do specific task by self reconstruction nature

**UNIT I AUTONOMIC BEGINNING AND AUTONOMIC SYSTEM 9**

Introduction – Definitions – Autonomous Computing Elements – Self Configuring – Self Optimizing – Self Healing – Self Protection – Open Standards – Complexity

**UNIT II AUTONOMOUS COMPUTING ARCHITECTURE AND OPEN STANDARD 9**

Introduction – Control Loops – Autonomic Component Description – Autonomic Manager Collaboration – Autonomic Manager Development – Architecture - Monitoring function – Adaptation function – Decision function – Autonomic Computing and Open Standards

**UNIT III AUTONOMIC FEATURES AND IMPLEMENTATION CONSIDERATIONS 9**

Self Configuring – Self Optimizing – Self Healing – Self Protection – Autonomic Implementation consideration – Evaluation Issues – Learning Environment

**UNIT IV AUTONOMIC NETWORKING 9**

Toward Autonomic Network – Autonomic Networking in Wireless Sensor Networks – Network Reconfiguration in High Performance Interconnection Networks – Concepts for Self Protection – Formal Aspects of Self - * in Autonomic Networked Computing Systems

**UNIT V AUTONOMIC RESEARCH CHALLENGE 9**

Research Challenges – The Life Cycle of an Autonomic Element – Relationships among Autonomic Elements – Scientific Challenges – Research Projects in Autonomic Computing – University Research Projects in Autonomic Computing - The state of Autonomic Computing Today

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Students learn models and systems that heal, install and protect themselves based on the need by automatically
- Know how to design an adaptive system with less cost, enhanced service and agility
- Knowledge for planning and implementing autonomic technology for current information enriched world
- Know the research and thrust areas in autonomic computing in real time application environment

**REFERENCES:**


1. Richard Murch, Autonomic Computing, IBM Press, March 2004
2. Lalanda, Philippe**,** McCann, Julie A., Diaconescu, AdaAutonomic Computing: Principles, Design and Implementation, Springer Book Series, ISBN 978-1-4471-5006-0, 2013
3. Yan Zhang, Laurence Tianruo Yang and Mieso K. Denko, Autonomic Computing and Networking, Springer Book Series, 2009.


**MP7006 HAPTIC TECHNOLOGY L T P C**

**3 0 0 3**

**OBJECTIVES**:

To provide an overview of Haptic technology and enable the student to create applications in a collaborative environment.

**OUTCOMES**:

Upon the completion of this course given in the curriculum, students should be able to

- Demonstrate knowledge in human perception,Machine and Multimedia Haptics**.**
- Create integrated and collaborative haptic systems
- Analyze and characterize Human , Multimedia and machine haptics

**UNIT I INTRODUCTION 9**

Human Senses-Haptic Exploration-Concepts and Terminology-Roadmap to Multimedia Haptics - Haptic Multimedia Audio and Visual System-Haptic Evolution-Haptics for Medical Application-Tele Robotics and Tele operation-Media-Mobile Haptics-Virtual reality-Learning and Education-Haptic Security

**UNIT II HUMAN HAPTIC PERCEPTION AND MACHINE HAPTICS 9**

Touch and Cognition-Human Haptic System-Concept of Illusion-Human Perceptual parameters for Interface Development-Haptic Interfaces-HAVE Sensors- HAVE Actuators-Performance Specifications-State-of-Art Haptic interfaces

**UNIT III COMPUTER HAPTICS 10**

Haptic Rendering Subsystem-Polygon based Representation and Scene Graph-Collision Detection Techniques and Bounding Volumes-Penetration Depth and Collision Response-Haptic Rendering of Surface Properties-Haptic Rendering of other Representation methods- Haptic Rendering of more than 3-DOF-Control Methods for Haptic systems-Benchmarking Haptic Rendering systems- Haptic Software Frameworks

**UNIT IV MULTIMEDIA HAPTICS 9**

Haptic as a new media-HAVE Content Creation- Content Representation-Hap tic Media Transmission-Architecture for C-HAVE-Communication Framework for C-HAVE systems-Quality of Experience in Multimedia Haptics-Haptics WaterMarking.

**UNIT V TOUCHING THE FUTURE: CHALLENGES AND TRENDS 8**

The Golden Age of Haptics-Human Haptics-Machine Haptics-Computer Haptics-Multimedia Haptics Haptic Technology In Surgical Simulation and Medical Training- Haptic Devices- Haptic Rendering-Applications of Haptic technology.

**TOTAL: 45 PERIODS**

**REFERENCES:**


1. Abdulmotaleb El Saddik, Mauricio Orozco, Mohamad Eid, Jongeun Cha “Haptics Technologies: Bringing Touch to Multimedia” (Springer Series on Touch and Haptic Systems)
2. http://haptic.mech.nwu.edu
3. http://www.webopedia.com/TERM/H/haptic.html
4. http://www.stanford.edu/dept/news/report/news/2003/april2/haptics-42.html
5. http://www.utoronto.ca/atrc/rd/vrml/haptics.html
6. http://www.caip.rutgers.edu/~bouzit/lrp/glove.html


**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 – Map Reduce , Twister and Iterative MapReduce – Hadoop Library from Apache – Mapping Applications - Programming Support - Google App Engine, Amazon AWS - Cloud Software Environments -Eucalyptus, Open Nebula, Open Stack, 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:**

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

- 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.Tamarai 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

**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.


**MP7007 NANO COMPUTING L T P C**

**3 0 0 3**

**OBJECTIVES:**

To have an understanding the foundations of Nano Computing.

- To understand the fundamental principles of Dielectrics and Electronic Structures.
- To know the construction and working of Logic Devices.
- To know the construction and working of mass storage devices.
- To study sensor arrays and Imaging systems
- To know about various types of Display.

**UNIT I INTRODUCTION 9**

Dielectrics – Ferroelectrics - Electronic Properties and Quantum Effects – Magneto electronics – Magnetism and Magneto transport in Layered Structures - Organic Molecules – Electronic Structures, Properties, and Reactions - Neurons – The Molecular Basis of their Electrical Excitability - Circuit and System Design.

**UNIT II LOGIC DEVICES 9**

Silicon MOSFETs – Novel Materials and Alternative – Concepts - Ferroelectric Field Effect Transistors - Quantum Transport devices Based on Resonant Tunnelling - Single-Electron Devices for Logic Applications - Superconductor Digital Electronics - Quantum Computing Using Superconductors - Carbon Nano tubes for Data Processing - High-Permittivity Materials for DRAMs - Ferroelectric Random Access Memories Magneto resistive RAM.

**UNIT III MASS STORAGE DEVICES 9**

Hard Disk Drives - Magneto-Optical Discs - Rewriteable DVDs Based on Phase Change Materials - Holographic Data Storage - AFM-Based Mass Storage – The Millipede Concept - Transmission on Chip and Board Level - Photonic Networks - Microwave Communication Systems – Novel Approaches for Passive Devices – Neuro electronic Interfacing: Semiconductor Chips with Ion Channels, Nerve Cells and Brain.

**UNIT IV SENSOR ARRAYS AND IMAGING SYSTEMS 9**

Optical 3-D Time-of-Flight Imaging System – Pyro electric Detector Arrays for IR Imaging - Electronic Noses. 2-D Tactile Sensors and Tactile Sensor Arrays.

**UNIT V DISPLAYS 9**

Liquid Crystal Displays - Organic Light Emitting Devices - Field-Emission and Plasma Displays - Electronic Paper.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon Completion of the course, the students will be able

- To design the basic components in Nano Computing .
- To construct the Logic Devices
- To design the storage devices
- To analyze different types of imaging systems.
- To analyze the principles of Various Displays LCD, LED and Plasma Displays.

**REFERENCES:**


1. RainerWaser, Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices, WileyVCH, April 2003.
2. Nano computing: Computational Physics for Nano science and Nanotechnology, Jang-Yu Hsu, CRC Press ,2009.
3. Nano computing:The Future of Computing, Vishal Sahni Tata McGraw Hill,2008.
4. Nano, Quantum and Molecular Computing:Implications to High level design and validation ,Shukla,Sandeep Kumar,2004,Springer
5. Bio Inspired Nano scale Integrated computing, Marymehrnoosh eshaghian –wilner,2009,John wiley publications.
6. N. K. Jha and D. Chen, Editors, Nanoelectronic Circuit Design, Springer, 2011.
7. W. Zhang, N.K.Jha, and L. Shang, ‘‘A hybrid nano/CMOS dynamically reconfigurable system," book chapter in Nanoelectronic Circuit Design, Springer, 2011.

**MP7008** **SEMANTIC WEB** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To build and implement a small ontology that is semantically descriptive of your chosen problem domain.
- implement applications that can access, use and manipulate the ontology, represent data from a chosen problem in XML with appropriate semantic tags obtained or derived from the ontology, depict the semantic relationships among these data elements using Resource Description Framework (RDF), via the semantic web (which includes the RDF, data elements in properly tagged XML, and the ontology),
- discover the capabilities and limitations of semantic web technology for different applications.

**UNIT I INTRODUCTION 9**

Components – Types – Ontological Commitments – Ontological Categories – Philosophical background –KnowledgeRepresentation Ontologies – TopLevel Ontologies – Linguistic Ontologies – Domain Ontologies – Semantic Web – Need – Foundation – Layers–Architecture.

**UNITII LANGUAGES FOR SEMANTIC WEB AND ONTOLOGIES 10**

Web Documents in XML – RDF - Schema – Web Resource Description using RDF- RDF Properties – Topic Maps and RDF – Overview – Syntax Structure – Semantics –Pragmatics - traditional Ontology Languages – LOOM- OKBC – OCML - Flogic Ontology Markup Languages– SHOE–OIL-AML-OIL-OWL

**UNIT III ONTOLOGY LEARNING FOR SEMANTIC WEB 10**

Taxonomy for Ontology Learning – Layered Approach – Phases of Ontology Learning – Importing and Processing Ontologies andDocuments– Ontology LearningAlgorithms- Evaluation

**UNIT IV ONTOLOGY MANAGEMENT AND TOOLS 9**

Overview – need for management – development process – target ontology – ontology mapping – skills management system – ontological class – constraints – issues.Evolution– Development of Tools and Tool Suites – Ontology Merge Tools – Ontology based Annotation Tools.

**UNIT V APPLICATIONS 7**

Web Services – Semantic Web Services - Case Study for specific domain – Security issues – current trends.

**TOTAL : 45 PERIODS**

**REFERENCES:**


1. Asuncion Gomez-Perez, Oscar Corcho, Mariano Fernandez-Lopez, “Ontological Engineering: with examples from the areas of Knowledge Management, e-Commerce and the Semantic Web” Springer, 2004
2. Grigoris Antoniou, Frank van Harmelen, “A Semantic Web Primer (Cooperative Information Systems)”,The MIT Press, 2004
3. Alexander Maedche, “Ontology Learning for the Semantic Web”, Springer; 1 edition, 2002
4. John Davies, Dieter Fensel, Frank Van Harmelen, “Towards the Semantic Web: Ontology – Driven Knowledge Management”, John Wiley & Sons Ltd., 2003.
5. Dieter Fensel (Editor), Wolfgang Wahlster, Henry Lieberman, James Hendler, “Spinning the Semantic Web: Bringing the World Wide Web to Its Full Potential”, The MITPress,2002 .

6. Michael C. Daconta, Leo J. Obrst, Kevin T. Smith, "The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management", Wiley, 2003
7. Steffen Staab (Editor), Rudi Studer, "Handbook on Ontologies (International Handbooks on Information Systems)", Springer 1st edition, 2004.

**OUTCOMES:**

Upon the completion of this course given in the curriculum, students should be able to

- design and implement a web services application that "discovers" the data and/or other web services
- Demonstrate knowledge in the basic of semantic web and ontologies.
- Design semantic web application