M.TECH. INFORMATION TECHNOLOGY

Total Contact Hours = 24 **Total Marks = 600** **Total Credits = 22**

SEMESTER 1st		Contact Hrs			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MITE2-101	Information Security	3	1	0	40	60	100	4
MITE2-102	Advance Database Systems	3	1	0	40	60	100	4
MITE2-103	Network Security	3	1	0	40	60	100	4
MITE2-104	Research Lab. - I	0	0	4	60	40	100	2
Departmental Elective – I (Select any one)		3	1	0	40	60	100	4
MITE2- 156	Mobile Computing							
MITE2-157	Mobile Application Development							
MITE2-158	Real Time & Embedded Systems							
Departmental Elective – II (Select any one)		3	1	0	40	60	100	4
MITE2-159	Advance Software Engineering							
MITE2-160	Object Oriented Analysis & Design							
MITE2-161	Advanced Internet & Web Technologies							
Total		**15**	**5**	**4**	**260**	**340**	**600**	**22**

Total Contact Hours = 20 **Total Marks = 600** **Total Credits = 22**

SEMESTER 2nd		Contact Hrs			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MITE2-205	Advanced Operating System	3	1	0	40	60	100	4
MITE2-206	Distributed System	3	1	0	40	60	100	4
MITE2-207	Advanced Operating System Lab.	0	0	4	60	40	100	2
Departmental Elective – III (Select any one)		3	1	0	40	60	100	4
MITE2- 262	Big Data							
MITE2-263	Cloud Computing							
MITE2-264	Virtualization and Cloud Security							
Departmental Elective – IV (Select any one)		3	1	0	40	60	100	4
MITE2-265	Data warehousing & Data Mining							
MITE2-266	Adhoc & Sensor Networks							
MITE2-267	Enterprise Response Planning							
Open Elective-I (Select any one)		3	1	0	40	60	100	**4**
Total		**15**	**5**	**4**	**260**	**340**	**600**	**22**

Total Contact Hours = 22 **Total Marks = 400** **Total Credits = 22**

SEMESTER 3rd		Contact Hrs			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MITE2-308	Project	-	-	10	60	40	100	10
MITE2-309	Seminar	-	-	4	60	40	100	4
MREM0-101	Research Methodology	3	1	-	40	60	100	4
Departmental Elective –V (Select any one)		3	1	-	40	60	100	4
MITE2-368	Soft Computing							
MITE2-369	Digital Image Processing							
MITE2-370	Parallel Computing							
Total		**6**	**2**	**14**	**200**	**200**	**400**	**22**

SEMESTER 4th		Contact Hrs.			Evaluation Criteria	Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Satisfactory/ Unsatisfactory**	
MITE2-410	**Thesis**	**0**	**0**	**20**		**24**

Overall

Semester	Marks	Credits
1st	600	22
2nd	600	22
3rd	600	22
4th	---	24
Total	**1800**	**90**

INFORMATION SECURITY

Subject Code – MITE2- 101 **L T P C** **Duration – 45 Hrs.**
3 1 0 4

UNIT-I (12 Hrs.)

Topics in Elementary Number Theory: O and Ω notations – Time Estimates for Doing Arithmetic – Divisibility and The Euclidean Algorithm – Congruence: Definitions and Properties – Linear congruence, Residue Classes, Euler's Phi Function – Fermat's Little Theorem – Chinese Remainder Theorem – Applications to Factoring – Finite Fields – Quadratic Residues and Reciprocity: Quadratic residues – Legendre Symbol – Jacobi symbol.

UNIT-II (11 Hrs.)

Simple Cryptosystems: Enciphering Matrices – Encryption Schemes – Symmetric and Asymmetric Cryptosystems – Cryptanalysis – Block ciphers –Use of Block Ciphers – Multiple Encryption – Stream Ciphers –Affine cipher – Vigenere, Hill and Permutation Cipher – Secure Cryptosystem

UNIT-III (10 Hrs.)

Public Key Cryptosystems: The Idea of Public Key Cryptography – The Diffie–Hellman Key Agreement Protocol - RSA Cryptosystem – Bit security of RSA – ElGamal Encryption - Discrete Logarithm – Knapsack problem – Zero-Knowledge Protocols – From Cryptography to Communication Security - Oblivious Transfer.

UNIT-IV (12 Hrs.)

Primality and Factoring: Pseudo primes – The Rho (Γ) Method – Format Factorization and Factor Bases – The Continued Fraction Method – The Quadratic Seieve Method. Number Theory and Algebraic Geometry: Elliptic Curves – Basic Facts – Elliptic Curve Cryptosystems – Elliptic Curve Primality Test – Elliptic Curve Factorization. Note: Theorem Proofs are excluded for Examination but The Statements of the Theorems and Solving Problems Are Included.

Recommended Books

1. Neal Koblitz, 'A Course in Number Theory and Cryptography', 2nd Edn., Springer, **2002.**
2. Johannes A. Buchman, 'Introduction to Cryptography', 2nd Edn., Springer, **2004.**
3. Serge Vaudenay, 'Classical Introduction to Cryptography – Applications for Communication Security', Springer, **2006.**
4. Victor Shoup, 'A Computational Introduction to Number Theory and Algebra', Cambridge University Press, **2005.**
5. A. Manezes, P. Van Oorschot and S. Vanstone, 'Hand Book of Applied Cryptography', CRC Press, **1996.**
6. S.C. Coutinho, 'The Mathematics of Ciphers – Number Theory and RSA Cryptography', A.K. Peters, Natick, Massachusetts, **1998.**

ADVANCED DATABASE SYSTEM

Subject Code – MITE2-102 **L T P C** **Duration - 45 Hrs.**
3 1 0 4

UNIT-I (12 Hrs.)

Parallel Databases: Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures – Parallel Systems- Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra Operation Parallelism – Case Studies.

UNIT-II (13 Hrs.)

Object Oriented Database: Object Oriented Databases – Introduction – Weakness of RDBMS – Object Oriented Concepts Storing Objects in Relational Databases – Next Generation Database Systems – Object Oriented Data models – OODBMS Perspectives – Persistence – Issues in OODBMS – Object Oriented Database Management System Manifesto – Advantages and Disadvantages of OODBMS – Object Oriented Database Design – OODBMS Standards and Systems – Object Management Group – Object Database Standard ODMG – Object Relational DBMS –Postgres - Comparison of ORDBMS and OODBMS.

UNIT-III (11 Hrs.)

Web Database: Web Technology and DBMS – Introduction – The Web – The Web as a Database Application Platform – Scripting languages – Common Gateway Interface – HTTP Cookies – Extending the Web Server – Java – Microsoft's Web Solution Platform– Oracle Internet Platform – Semi structured Data and XML – XML Related Technologies – XML Query Languages.

UNIT-IV (10 Hrs.)

Intelligent Database: Enhanced Data Models for Advanced Applications – Active Database Concepts and Triggers – Temporal Database Concepts – Deductive databases – Knowledge Databases. **Current Trends:** Mobile Database – Geographic Information Systems – Genome Data Management – Multimedia Database – Parallel Database – Spatial Databases - Database administration – Data Warehousing and Data Mining.

Recommended Books

1. Thomas M. Connolly, Carolyn E. Begg, 'Database Systems - A Practical Approach to Design, Implementation, and Management', 3rd Edn., Pearson Education, **2003.**
2. Ramez Elmasri & Shamkant B. Navathe, 'Fundamentals of Database Systems', 4th Edn., Pearson Education, **2004.**
3. Tamer Ozsu M., Patrick Ualduriel, 'Principles of Distributed Database Systems', 2nd Edn., Pearson Education, **2003.**
4. C.S.R. Prabhu, 'Object Oriented Database Systems', PHI, **2003.**
5. Peter Rob and Corlos Coronel, 'Database Systems – Design, Implementation and Management'.

NETWORK SECURITY

Subject Code – MITE2 - 103 **L T P C** **Duration – 45 Hrs**
3 1 0 4

UNIT-I (12 Hrs.)

Overview of Computer Networks, Seven-Layer Architecture, TCP/IP Suite of Protocols, Etc. MAC Protocols for High-Speed LANS, MANS and Wireless Lans, Introduction to Security in Networks, Intrusion Kinds of Security Breaches, Points of Vulnerability, Methods of Defense, Control Measures, Effectiveness of Controls.

UNIT-II (12 Hrs)

Basics of Encryption and Decryption, Encryption Techniques, Characteristics of Good Encryption Systems, Secret Key Cryptography, Data Encryption Standard, International Data Encryption Algorithm, Advanced Encryption Standard, Hash and MAC Algorithms.

UNIT-III (10 Hrs.)

Public Key Encryptions, Introduction to Number Theory, RSA Algorithm, Diffie-Hellman, Digital Signature Standard, Elliptic Curve Cryptography, Digital Signatures and Authentication, Trusted Intermediaries, Security Handshake Pitfalls.

UNIT-IV (11 Hrs.)

Secure Sockets, Ipsec Overview, IP Security Architecture, Ipsec-Internet Key Exchanging (IKE), IKE Phases, Encoding, Internet Security, Threats to Privacy, Packet Sniffing, Spoofing, Web Security Requirements, Real Time Communication Security, Security Standards, Kerberos, X.509 Authentication Service. Security Protocols - Transport Layer Protocols, SSL, Electronic Mail Security, PEM and S/MIME Security Protocol, Pretty Good Privacy. Web Security, Firewalls Design Principles, Trusted Systems, Electronic Payment Protocols, Intrusion Detection, Password Management, Viruses and Related Threats, Virus Counter Measures, Virtual Private Networks.

Recommended Books

1. William Stallings, 'Cryptography and Network Security: Principles and Standards', 3rd Edn., Prentice Hall India, **2003.**
2. Charlie Kaufman, Radia Perlman and Mike Speciner, 'Network Security: Private Communication in a public world', 2nd Edn., Prentice Hall India, **2002.**
3. Charles P. Pleeger, 'Security in Computing', 5th Edn., Pearson Education Asia, **2001**.
4. William Stallings, 'Network Security Essentials: Applications and standards', Pearson Education Asia, **2000.**

MOBILE COMPUTING

Subject Code – MITE2 - 156 **L T P C** **Duration - 45 Hrs.**
3 1 0 4

UNIT-I (10 Hrs.)

Introduction: Mobile Communications, Mobile Computing – Paradigm, Promises/Novel Applications and Impediments and Architecture; Mobile and Handheld Devices, Limitations of Mobile and Handheld Devices. GSM – Services, System Architecture, Radio Interfaces, Protocols, Localization, Calling, Handover, Security, New Data Services, GPRS, CSHSD, DECT.

UNIT-II (12 Hrs.)

(Wireless) Medium Access Control (MAC): Motivation for a specialized MAC (Hidden and exposed terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA, Wireless LAN/(IEEE 802.11) **Mobile Network Layer:** IP and Mobile IP Network Layers, Packet Delivery and Handover Management, Location Management, Registration, Tunnelling and Encapsulation, Route Optimization, DHCP.

UNIT-III (10 Hrs.)

Mobile Transport Layer: Conventional TCP/IP Protocols, Indirect TCP, Snooping TCP, Mobile TCP, Other Transport Layer Protocols for Mobile Networks. **Database Issues:** Database Hoarding & Caching Techniques, Client- Server Computing & Adaptation, Transactional Models, Query processing, Data Recovery Process & QoS Issues.

UNIT-IV (13 Hrs.)

Data Dissemination and Synchronization: Communications Asymmetry, Classification of Data Delivery Mechanisms, Data Dissemination, Broadcast Models, Selective Tuning and Indexing Methods, Data Synchronization – Introduction, Software, and Protocols **Mobile Ad hoc Networks (MANETs):** Introduction, Applications & Challenges of a MANET, Routing, Classification of Routing Algorithms, Algorithms such as DSR, AODV,

DSDV, Mobile Agents, Service Discovery. **Protocols and Platforms for Mobile Computing:** WAP, Bluetooth, XML, J2ME, Java Card, Palm OS, Windows CE, Symbian OS, Linux for Mobile Devices, Android.

Recommended Books

1. Jochen Schiller, 'Mobile Communications', 2nd Edn., Addison Wesely, Pearson Education.
2. Raj Kamal, 'Mobile Computing', Oxford University Press, **2007.**
3. Mazliza Othman, 'Principles of Mobile Computing and Communications:', Auerbach Publications.
4. William Stallings, 'Wireless Communications and Networks', Prentice Hall, **2005.**
5. M. Richharia, 'Mobile Satellite Communication: Principles and Trends', Pearson Education.

MOBILE APPLICATION DEVELOPMENT

Subject Code – MITE2-157 **L T P C** **Duration - 45 Hrs.**
3 1 0 4

UNIT-I (10 Hrs.)

Introduction: Mobile Development Importance, Survey of mobile based application development, Mobile myths, third party frameworks, Mobile Web Presence and Applications, creating consumable web services for mobile, JSON, Debugging Web Services, Mobile Web Sites, Starting with Android mobile Applications.

UNIT-II (13 Hrs.)

Mobile Web: Introduction, WAP1, WAP2, Fragmentation Display, Input Methods, Browsers and Web Platforms, Tools for Mobile Web Development. **Application Architectures and Designs:** Mobile Strategy, Navigation, Design and User Experience, WML, XHTML Mobile Basics, Mobile HTML5, CSS for Mobile, WCSS extensions, CSS3, CSS for mobile browsers, HTML5 Compatibility levels, Basics of Mobile **HTML5:** Document Head, Document Body, HTML5 Mobile Boilerplate, the Content, HTML5 Forms: Design, Elements, Attributes, Validation.

UNIT-III (10 Hrs.)

Devices, Images, Multi-Media: Device Detection, Client-side Detection, Server-side Detection, Device Interaction, Images, Video, Audio, Debugging and Performance, Content Delivery, Native and Installed Web Apps.

UNIT-IV (12 Hrs.)

Advanced Tools & Techniques: J2ME programming basics, HTML5 Script Extensions, Code Execution, Cloud based browsers, JS Debugging and pro ling, Background Execution, Supported Technologies and API, Standard JavaScript Behaviour, Java Libraries, Mobile Libraries, UI Frameworks: Sencha Touch, JQuery Mobile, Enyo, Montage, iUI, jQTouch, JavaScript Mobile UI Pattern **Advanced Applications:** Geolocation and Maps app, Online Apps, Storage, and Networks, Distribution and Social Web 2.0

Recommended Books

1. Je McWherter, Scott Gowell, 'Professional Mobile Application Development', John Wiley & Sons.
2. Maximiliano Firtman, 'Programming the mobile Web', 2nd Edn., Oreilly, **2013.**
3. 'Digital Content': http://en.wikibooks.org/wiki/Category: J2ME Programming.
4. 'Android Studio Development Essentials', Ref: http://www.techotopia.com/.

REAL TIME & EMBEDDED SYSTEMS

Subject Code – MITE2-158 **L T P C** **Duration - 45 Hrs.**
3 1 0 4

UNIT-I (12 Hrs.)

Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems, Design cycle in the development phase for an embedded system, Use of software tools for development of an ES.

UNIT-II (12 Hrs.)

Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: On board and External Communication Interfaces.

UNIT-III (11 Hrs.)

Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages. **RTOS Based Embedded System Design:** Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

UNIT-IV (10 Hrs.)

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, how to Choose an RTOS.

Recommended Books

1. K.V. Shibu, 'Introduction to Embedded Systems', McGraw Hill Publications.
2. Raj Kamal, 'Embedded Systems', Tata McGraw Hill.
3. Frank Vahid, Tony Givargis, 'Embedded System Design', John Wiley.
4. Lyla, 'Embedded Systems', Pearson Education, **2013.**
5. David E. Simon, 'An Embedded Software Primer', Pearson Education.

ADVANCED SOFTWARE ENGINEERING

Subject Code – MITE2-159 **L T P C** **Duration - 45 Hrs.**
3 1 0 4

UNIT-I (12 Hrs.)

Principles and Motivations: History, Definitions; Engineering Approaches to Software Development: Software Development Process Models from The Points of View of Technical Development and Project Management: Waterfall, Rapid Prototyping, Incremental Development, Spiral Models, Agile Software Development, Emphasis on Computer-Assisted Environments. Selection of Appropriate Development Process.

Software Development Methods: Formal, Semi-Formal and Informal Methods; Requirements elicitation, requirements specification; Data, Function and Event Based Modelling; Some of the popular methodologies such as Your dons SAD, SSADM etc; CASE Tools-Classification, Features, Strengths and Weaknesses; ICASE; CASE standards.

UNIT-II (11 Hrs.)

Software Project Management: Principles of Software Projects Management; Organizational and Team Structure; Project Planning; Project Initiation and Project Termination, Technical, Quality, and Management Plans; Project Control; Cost Estimation Methods: Function Points and COCOMO.

UNIT-III (11 Hrs.)

Software Quality Management: Quality Control, Quality Assurance and Quality Standards with Emphasis on ISO 9000; Functions of Software QA Organization in A Project; Interactions with Developers; Quality Plans, Quality Assurance Towards Quality Improvement; Role of Independent Verification & Validation; Total Quality Management; SEI Maturity Model; Software Metrics.

UNIT-IV (11 Hrs.)

Configuration Management: Need for Configuration Management; Configuration Management Functions and Activities; Configuration Management Techniques; Examples and Case Studies. **Software Testing Fundamentals**: Basic Terminology, Testing Techniques and Strategies. Brief Introduction to Various Standards Related to Software Engineering.

Recommended Book

1. Roger Pressman, 'Software Engineering - A Practitioners Approach', McGraw Hill.
2. Ian Sommerville, 'Software Engineering', Addison-Wesley Publishing Company.
3. James F. Peter, Software Engineering - An Engineering Approach, John Wiley.
4. Pankaj Jalote, 'An integrated Approach to Software Engineering', Narosa.

OBJECT ORIENTED ANALYSIS AND DESIGN

Subject Code: MITE2-160 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

Learning Objectives

To give students the detailed knowledge about Objects, Classes, types of modelling and detailed system design students will also come across the comparison of different methodologies.

Learning Outcomes

CO1 Understanding Objects and classes and concept of generalization and inheritance
CO2 Learning Dynamic modelling and various functional models
CO3 Understanding system design and Object design
CO4 Comparing various methodologies and their implementation

UNIT-I (11 Hrs.)

Introduction to Object: Object Orientation, Development, Modelling, Object Modelling technique. Objects and classes, Links and Association, Generalization and inheritance, Grouping constructs, Aggregation, Abstract Classes, Generalization as extension and restriction, multiple inheritance, Meta data, Candidate keys, Constraints.

UNIT-II (12 Hrs.)

Dynamic Modelling: Events and states, Nesting, Concurrency, Advanced Dynamic Modelling concepts, Functional modelling: Functional Models, Data flow diagrams, Specifying operations, Constraints, Relation of Functional model to Object and Dynamic Models.

Design Methodology, Analysis: Object modelling, Dynamic modelling, Functional modelling, adding operations, Iterating Analysis.

UNIT-III (11 Hrs.)

System design: Subsystems Concurrency, Allocation to processor and tasks, Management of data stores, Handling Global Resources, Handling boundary Conditions, Setting Trade-off priorities.

Object Design: Overview, Combining the three models, Designing Algorithms, Design Optimization, Implementation of Control, Adjustment of Inheritance, Design of Associations, Object Representation, Physical Packaging, and Document Design Decision.

UNIT-IV (11 Hrs.)

Comparison of Methodologies: Structured Analysis/Structured Design, Jackson Structured **Development. Implementation**: Using Programming Language, Database System, outside Computer.

Programming Style: Object Oriented Style, Reusability, Extensibility, Robustness, and Programming-in-the-large.

Recommended Books

1. Rambough, 'Object Oriented Modelling and Design', Pearson Education.
2. BOOCH, 'Object Oriented Analysis and Design', Addison Wesley.
3. Rebecca Wirfs-Brock, 'Design Object Oriented Software', PHI.

ADVANCED INTERNET & WEB TECHNOLOGIES

Subject Code – MITE2-161 **L T P C** **Duration - 45 Hrs**
3 1 0 4

UNIT-I (10 Hrs.)

Introduction: Internet Protocol Model, Internet Addresses, IP Routing Concepts, Table Driven and Next Hop Routing, Other Routing Related Protocols, Internet Access Through PPP, SLIP, WWW, Web Servers, Browsers.

UNIT-II (12 Hrs.)

Name Services and Configuration: DNS, DHCP, X500 Directory Services, LDAP, Internet Security, Authentication and Encryption, Watermarks, Firewall, SSL, Digital Signatures. **Web Services:** Web Services, Evolution and Differences with Distributed Computing, XML, WSDL, SOAP, UDDI, Transactions, Business Process Execution Language for Web Services, WS-Security and The Web Services Security Specifications, WS-Reliable Messaging, WS-Policy, WS-Attachments. Web 2.0 Technologies: Introduction to Ajax, Ajax Design Basics, Java script, Blogs, Wikis, RSS Feeds.

UNIT-III (11 Hrs.)

Content Delivery and Preparation: Introduction to WWW, TCP/IP, HTTP, FTP, UDP, N-Tier, Markup Languages VRML–HTML, DHTML, DNS, URL, Browsers, Platform for Web Services Development, MVC Design Pattern, .NET, J2EE Architecture, J2EE Components & Containers, Specification, Application Servers, Struts.

UNIT-IV (12 Hrs.)

Dynamic Web Programming: Java Applets, Java Script, JSP, JSTL, ASP, PHP, Servlets, Servlet Life Cycle, C#, Component Technologies, Java Beans, CORBA, Introduction to Ejbs, JDBC, Secure Electronic Transactions Over Web.

Introduction to Cloud Computing: Cloud Computing- History of Cloud Computing, Cloud Architecture, Cloud Storage, Why Cloud Computing Matters, Pros and Cons Of Cloud Computing, Companies in The Cloud Today, Cloud Services.

Recommended Books

1. E. Balagurusamy, 'Programming with Java', 4th Edn., Tata McGraw-Hill Education, **2009.**

2. E. Ladd and J. O'Donnell, 'Platinum Edition Using Xhtml, Xml and Java 2', 4th Edn., Que Publishing, **2001**
3. P.J. Deitel, H. Deitel and A. Deitel, 'Internet and World Wide Web How to Program', 5th Edn., India: Pearson Education Limited, **2011.**
4. M. August Miller, 'Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online', Que Publishing, **2008.**

ADVANCED OPERATING SYSTEM

Subject Code: MITE2-205 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

UNIT-I (11 Hrs.)

Processes and Scheduling: Process States and System Call Interface; Life Cycle of a Process: Process Dynamics; Scheduler: working and implementation; Linux Process States and System Calls; Process Groups, Sessions, Foreground and Background Processes.

UNIT-II (11 Hrs.)

Interprocess Communication and Synchronisation: Signals, Pipes and Named Pipes (FIFOs); Threads and pthread library; Mutexes and Condition Variables; Semaphores; Producer-Consumer Problem and Solutions using mutexes, condition variables and semaphores.

UNIT-III (12 Hrs.)

Files and File Systems: File and File Meta-data; File Naming Systems; File System Operations; File System Implementation; File System Structures; Booting an OS; File System Optimisation. Devices and Device Drivers: Devices and Types of Devices; Terminal, Disk, SCSI, Tape and CD devices; Unification of Files and Devices; Device Drivers: Concepts and Implementation Details

UNIT-IV (11 Hrs.)

Resource Management and Security: Resource Management Issues; Types of Resources; Integrated Resource Scheduling; Queuing Models of Scheduling; Protection of Resources – hardware, software, and attacks; Security Policies.

Recommended Books

1. Charles Crowley, 'Operating Systems: A Design-Oriented Approach', Tata McGraw-Hill.
2. Richard Stevens, Stephen Rago, 'Advanced Programming in the Unix Environment', Addison-Wesley.
3. M. Maekawa and Arthur E. Oldehoeft and R. R. Oldehoeft, 'Operating Systems: Advanced Concepts', Benjamin Cummings.

DISTRUBUTED SYSTEMS

Subject Code: MITE2-206 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

1. Characterization of Distributed Systems: Introduction, system models –Architectural and fundamental models
2. Interprocess communication: API for internet protocol, Marshalling. Client server communication, group communication case study: unix
3. Distributed objects and remote invocation: communication between Distributed objects, RPC, events and notification case study: Java RMI
4. Operating System Support: Operating System layer. Protection, processes and threads, operating system architecture

5. Distributed File System: File service architecture, network file system, Sun network file system, Andrew file system Case Study: unix
6. Name services: Name services and domain name system. directory and discovery services Case Study: Global Name service
7. Transaction and concurrency control: transactions, nested transactions, Locks, optimistic concurrency control, time stamp ordering, Comparison of methods for concurrency control
8. Distributed transaction: Flat and nested distributed transactions. Atomic Commit protocol, Distributed dead locks
9. Distributed Multimedia systems; characteristics of multimedia, multimedia data. Quality of service management, resource management, stream adaptation. Case study; Tiger video file server.
10. Distributed shared memory: design and implementation issues, sequential consistency and Ivy and Release Consistency an Munin Case Study of distributed systems: CORBA.

Recommended Books

1. G. Coulouis, et al, 'Distributed Systems: Concepts and Design', Pearson Education Asia, **2004.**
2. A.S. Tanenbaum, 'Modern operating Systems', Prentice Hall.

ADVANCED OPERATING SYSTEM LAB.

Subject Code: MITE2-207 **L T P C**
0 0 4 2

EXPERIMENTS

1. Write programs using the following system calls of UNIX operating system: Fork, exec, getpid, exit, wait, close, stat, opendir, readdir.
2. Write programs using the I/O system calls of UNIX operating system (open, read, write, etc.).
3. Write C programs to simulate UNIX commands like ls, grep, etc.
4. Given the list of processes, their CPU burst times and arrival times, display/print the Gantt chart for FCFS and SJF. For each of the scheduling policies, compute and print the average waiting time and average turnaround time.
5. Given the list of processes, their CPU burst times and arrival times, display/print the Gantt chart for Priority and Round robin. For each of the scheduling policies, compute and print the average waiting time and average turnaround time.
6. Developing Application using Inter Process Communication (using shared memory, pipes or message queues).
7. Implement the Producer – Consumer problem using semaphores (using UNIX system calls).
8. Implement some memory management schemes – I
9. Implement some memory management schemes – II
10. Implement any file allocation technique (Linked, Indexed or Contiguous).

BIG DATA

Subject Code: MITE2-262 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

UNIT-I (11 Hrs.)

Introduction to Big Data: Introduction – distributed file system – Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics, Big data applications. Algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce.

UNIT-II (10 Hrs.)

Introduction to Hadoop: Big Data – Apache Hadoop & Hadoop EcoSystem – Moving Data in and out of Hadoop – Understanding inputs and outputs of MapReduce - Data Serialization.

UNIT-III (11 Hrs)

Hadoop Architecture: Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands, Anatomy of File Write and Read., NameNode, Secondary NameNode, and DataNode, Hadoop MapReduce paradigm, Map and Reduce tasks, Job, Task trackers - Cluster Setup – SSH & Hadoop Configuration – HDFS Administering –Monitoring & Maintenance.

UNIT-IV (13 Hrs.)

Hadoop Ecosystem and Yarn: Hadoop ecosystem components - Schedulers - Fair and Capacity, Hadoop 2.0 New FeaturesNameNode High Availability, HDFS Federation, MRv2, YARN, Running MRv1 in YARN.

Hive and HiveQL, HBase: Hive Architecture and Installation, Comparison with Traditional Database, HiveQL - Querying Data - Sorting and Aggregating, Map Reduce Scripts, Joins & Subqueries, HBase conceptsAdvanced Usage, Schema Design, Advance Indexing - PIG, Zookeeper - how it helps in monitoring a cluster, HBase uses Zookeeper and how to Build Applications with Zookeeper. Practical: (45 hours)

Recommended Books

1. Boris lublinsky, Kevin T. Smith, Alexey Yakubovich, 'Professional Hadoop Solutions', Wiley.
2. Chris Eaton, Dirk deroos et al, 'Understanding Big Data', McGraw Hill.
3. Vignesh Prajapati, 'Big Data Analytics with R and Haoop', Packet Publishing.
4. Tom Plunkett, Brian Macdonald et al, 'Oracle Big Data Handbook', Oracle Press.
5. Jy Liebowitz, 'Big Data and Business Analytics', CRC Press.

CLOUD COMPUTING

Subject Code: MITE2-263 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

UNIT-I (11 Hrs.)

Introduction to Cloud Computing: Definition, Characteristics, Components, Cloud provider, SAAS, PAAS, IAAS and Others, Organizational scenarios of clouds, Administering &Monitoring cloud services, benefits and limitations, Deploy application over cloud, Comparison among SAAS, PAAS, IAAS, Cloud computing platforms: Infrastructure as service: Amazon EC2, Platform as Service: Google App Engine, Microsoft Azure.

UNIT-II (11 Hrs.)

Introduction to Cloud Technologies: Study of Hypervisors, SOAP, REST, Compare SOAP and REST, Web services, AJAX and mashups-Web services, Mashups: user interface services, Virtual machine technology, virtualization applications in enterprises, Pitfalls of virtualization, Multi-entity support, Multi-schema approach, Multi-tenance using cloud data stores, Data access control for enterprise applications.

UNIT-III (11 Hrs.)

Data in the Cloud: Relational databases, Cloud file systems: GFS and HDFS, Big Table, HBase and Dynamo, Map-Reduce and extensions: Parallel computing, the map-Reduce model, Parallel efficiency of Map-Reduce, Relational operations using Map-Reduce, Introduction to cloud development, Monitoring in Cloud, A grid of clouds, Mobile Cloud Computing, Sky computing, Utility Computing, Elastic Computing.

UNIT-IV (12 Hrs.)

Cloud Security: Fundamentals, Vulnerability assessment tool for cloud, Privacy and Security in cloud, Cloud computing security architecture, Cloud computing security challenges, Issues in cloud computing, implementing real time application over cloud platform, Issues in Inter-cloud environments, QoS Issues in Cloud, Dependability, data migration, streaming in Cloud. Quality of Service (QoS) monitoring in a Cloud computing environment, Inter Cloud issues, load balancing, resource optimization.

Recommended Books

1. Antohy T. Velte, et.al, 'Cloud Computing: A Practical Approach', McGraw Hill.
2. Judith Hurwitz, R. Bloor, M. Kanfman, F. Halper, 'Cloud Computing for Dummies', India Edn., Wiley.
3. S. Kumaraswammy, S. Latif, Tim Malhar, 'Cloud Security & Privacy', SPD,O'Reilly.
4. Barrie Sosinsky, 'Cloud Computing Bible', Wiley India.
5. George Reese, 'Cloud Applications', O'Reilly Publication.
6. Ronald Krutz and Russell Dean Vines, 'Cloud Security', Wiley-India.

VIRTUALIZATION & CLOUD SECURITY

Subject Code: MITE2-264 **L T P C** **Duration: 45 Hrs**
3 1 0 4

UNIT-I (11 Hrs.)

Security Concepts: Confidentiality, privacy, integrity, authentication, non-repudiation, availability, access control, defence in depth, least privilege, how these concepts apply in the cloud, what these concepts mean and their importance in PaaS, IaaS and SaaS. e.g. User authentication in the cloud;

Cryptographic Systems: Symmetric cryptography, stream ciphers, block ciphers, modes of operation, public-key cryptography, hashing, digital signatures, public-key infrastructures, key management, X.509 certificates, OpenSSL.

UNIT-II (12 Hrs.)

Multi-tenancy Issues: Isolation of users/VMs from each other. How the cloud provider can provide this;

Virtualization System Security Issues: e.g. ESX and ESXi Security, ESX file system security, storage considerations, backup and recovery;

Virtualization System Vulnerabilities: Management console vulnerabilities, management server vulnerabilities, administrative VM vulnerabilities, guest VM vulnerabilities, hypervisor vulnerabilities, hypervisor escape vulnerabilities, configuration issues, malware (botnets, etc.).

UNIT-III (10 Hrs)

Virtualization System-Specific Attacks: Guest hopping, attacks on the VM (delete the VM, attack on the control of the VM, code or file injection into the virtualized file structure), VM migration attack, hyperjacking.

UNIT-IV (12 Hrs.)

Technologies for Virtualization-Based Security Enhancement: IBM security virtual server protection, virtualization-based sandboxing; **Storage Security**: HIDPS, log management, Data Loss Prevention. Location of the Perimeter.

Legal and Compliance Issues: Responsibility, ownership of data, right to penetration test, local law where data is held, examination of modern Security Standards (PCIDSS), how standards deal with cloud services and virtualization, compliance for the cloud provider vs. compliance for the customer.

Recommended Books

1. Tim Mather, Subra Kumaraswamy, Shahed Latif, 'Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance', O'Reilly Media Inc., **2009.**
2. Ronald L. Krutz, Russell Dean Vines, 'Cloud Security'.
3. John Rittinghouse, James Ransome, 'Cloud Computing'.
4. J.R. ("Vic") Winkler, 'Securing the Cloud'.
5. Cloud Security Alliance, 'Security Guidance for Critical Areas of Focus in Cloud Computing', **2009.**

DATA WAREHOUSING & DATA MINING

Subject Code: MITE2-265 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

UNIT-I (11 Hrs.)

Basic Concepts of Data Warehousing Introduction, Meaning and characteristics of Data Warehousing, Online Transaction Processing (OLTP), Data Warehousing Models, Data warehouse architecture & Principles of Data Warehousing Data Mining.

Building a Data Warehouse Project Structure of the Data warehouse, Data warehousing and Operational Systems, organizing for building data warehousing, Important considerations – Tighter integration, Empowerment, Willingness Business Considerations: Return on Investment Design Considerations, Technical Consideration, Implementation Consideration, Benefits of Data warehousing.

UNIT-II (11 Hrs.)

Managing and Implementing a Data Warehouse Project Management Process, Scope Statement, Work Breakdown Structure and Integration, initiating a Data Warehouse project Project Estimation, Analysing Probability and Risk, Managing Risk: Internal and External, Critical Path Analysis.

UNIT-III (12 Hrs.)

Data Mining What is Data mining (DM)? Definition and description, Relationship and Patterns, KDD vs Data mining, DBMS vs Data mining, Elements and uses of Data Mining, Measuring Data Mining Effectiveness: Accuracy, Speed & Cost Data Information and Knowledge, Data Mining vs. Machine Learning, Data Mining Models. Issues and challenges in DM, DM Applications Areas.

Techniques of Data Mining Various Techniques of Data Mining Nearest Neighbour and Clustering Techniques, Decision Trees, Discovery of Association Rules, Neural Networks, Genetic Algorithm.

UNIT-IV (11 Hrs.)

OLAP Need for OLAP, OLAP vs. OLTP Multidimensional Data Model Multidimensional verses Multirelational OLAP Characteristics of OLAP: FASMI Test (Fast, Analysis Share,

Multidimensional and Information), Features of OLAP, OLAP Operations Categorization of OLAP Tools: MOLAP, ROLAP.

Recommended Books

1. Pieter Adriaans, Dolf Zantinge, 'Data Mining', Pearson Education.
2. George M. Marakas 'Modern Data Warehousing, Mining, and Visualization: Core Concepts', Prentice Hall.
3. Alex Berson, Stephen J. Smith, 'Data Warehousing, Data Mining and OLAP (Data Warehousing/Data Management)', McGraw Hill.
4. Margaret H. Dunham, 'Data Mining', Prentice Hall.
5. J.H. David, 'Principles of Data Mining' (Adaptive Computation and Machine Learning), Prentice Hall.

AD HOC AND SENSOR NETWORKS

Subject Code: MITE2-266 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

UNIT –I (11 Hrs.)

Introduction to Wireless Networks, Evolution of 3G Mobile Systems, Wireless LANs, Bluetooth, Scatternet, Piconet, Ad hoc Networks, Heterogeneity in Mobile Devices, Types of Ad hoc Mobile Communications, Types of Mobility, Challenges in Ad hoc Mobile Networks, Energy Management, Scalability, Addressing and Service Discovery, Deployment Considerations.

UNIT-II (10 Hrs.)

MAC protocols for Ad hoc Networks: Design issues, Classifications, Contention based protocols, MACAW, FAMA, BTMA, DBTMA, MACABI, Real-Time MAC protocol, Multichannel protocols, Power aware MAC, Routing protocols: Design issues, Table-driven protocols - DSDV, WRP, CGSR, On-Demand protocols - DSR, AODV, TORA, LAR, ABR, Zone Routing Protocol, Power Aware Routing protocols.

UNIT-III (12 Hrs.)

Multicast Routing, Preferred Link based Multicast, Mesh-based protocols, Core-Assisted Mesh protocol, Issues in Transport layer protocols, TCP over Ad hoc Networks, TCP Reno, Tahoe, Vegas, TCP SACK, Indirect TCP, Snooping TCP, Split-TCP, TCP-BuS, Quality of Service issues, MAC layer solutions, Network layer solutions, QoS framework for Ad hoc networks, INSIGNIA, INORA, SWAN.

Wireless Sensor Networks, Unique constraints and challenges, Applications, Collaborative processing, Architecture, Data Dissemination, MAC protocols, S-MAC, IEEE 802.15.4 and ZigBee, Geographic, Energy-Aware Routing, Attribute-based routing, Directed Diffusion, Rumor Routing, Geographic Hash Tables -GHT, Data Gathering, PEGASIS, Location Discovery, Localization, Communication and Sensing Coverage.

UNIT-IV (12 Hrs.)

Topology Control, Time Synchronization, Sensor Taking and Control, Sensor Selection, IDSQ, Cluster Leader-based Protocol, Joint Routing and Information Aggregation, Sensor Network Databases, Challenges, In-Network Aggregation, TinyDB query processing, DataCentric Storage, Data Indices and Range Queries, Distributed Hierarchical Aggregation, Temporal Data, Platforms and Tools, Berkeley Motes, Programming Challenges, TinyOS, nesC, TinyGALS, ns2 extensions, TOSSIM, Actuators.

Recommended Books

1. C. Siva Ram Murthy and B. S. Manoj, 'Ad Hoc Wireless Networks: Architectures and Protocols', Pearson Education, **2007.**
2. C.K. Toh, 'Ad Hoc Mobile Wireless Networks: Protocols and Systems', Pearson Education, **2007.**
3. Feng Zhao and Leonidas Guibas, 'Wireless Sensor Networks: An Information Processing Approach', Morgan Kaufman Publishers, **2007.**
4. Jochen Schiller, 'Mobile Communications', Pearson Education, **2009.**

ENTERPRISE RESOURCE PLANNING

Subject Code: MITE2-267 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

UNIT-I (12 Hrs.)

Introduction to ERP Evolution of ERP: what is ERP? Reasons for the Growth of ERP; Scenario and Justification of ERP in India; Evaluation of ERP; Various Modules of ERP; Advantage of ERP. Integrated Management Information; Business Modelling; ERP for Small Business; ERP for Make to Order Companies; Business Process Mapping for ERP Module Design; Hardware Environment and its Selection for ERP Implementation.

UNIT-II (11 Hrs.)

ERP and Related Technologies: Business Process Reengineering (BPR); Management Information System (MIS); Executive Information System (EIS); Decision support System (DSS); Supply Chain Management (SCM). ERP system Introduction; Finance, Plant Maintenance, Quality Management, Materials Management.

UNIT-III (10 Hrs.)

ERP Market: Introduction, SAP AG, Baan Company, Oracle Corporation, People Soft, JD Edwards World Solutions Company, System Software Associates, Inc. (SSA); QAD; A Comparative Assessment and Selection of ERP Packages and Modules.

UNIT-IV (12 Hrs.)

ERP Implementation Lifecycle: Issues in Implementing ERP Packages; Pre-evaluation Screening; Package Evaluation; Project Planning Phase; Gap Analysis; Reengineering; Configuration; Implementation; Team Training; Testing; Going Live; End-User Training; Post Implementation (Maintenance Mode).

Recommended Books

1. Khalid Sheikh, 'Manufacturing Resource Planning (MRP II) with Introduction to ERP, SCM; an CRM', McGraw-Hill.
2. Christian N. Madu, 'ERP and Supply Chain Management', CHI.
3. Glynn C. Williams, 'Implementing SAP ERP Sales & Distribution', McGraw-Hill.

RESEARCH METHODOLOGY

MREM0-101 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

COURSE OBJECTIVES:

To define research and describe the research process and research methods.

COURSE OUTCOMES:

CO1: Able to select and define appropriate research problem and Parameters.

CO2: Able to organize and conduct research in a more appropriate manner.
CO3: Able to understand and apply statistical me.

UNIT–I (11 Hrs.)

Introduction to Research: Meaning, Definition, OBJECTIVES and Process.
Research Design: Meaning, Types - Historical, Descriptive, Exploratory and Experimental.
Research Problem: Necessity of Defined Problem, Problem Formulation, Understanding of Problem, Review of Literature.
Design of Experiment: Basic Principal of Experimental Design, Randomized Block, Completely Randomized Block, Latin Square, Factorial Design.
Hypothesis: Types, Formulation of Hypothesis, Feasibility, Preparation and Presentation of Research Proposal.

UNIT–II (10 Hrs.)

Sources of Data: Primary and Secondary, Validation of Data.
Data Collection Methods: Questionnaire Designing, Construction.
Sampling Design & Techniques: Probability Sampling and Non Probability Sampling.
Scaling Techniques: Meaning & Types.
Reliability: Test – Retest Reliability, Alternative Form Reliability, Internal Comparison Reliability and Scorer Reliability.
Validity: Content Validity, Criterion Related Validity and Construct Validity.

UNIT–III (13 Hrs.)

Data Process Operations: Editing, Sorting, Coding, Classification and Tabulation.
Analysis of Data: Statistical Measure and Their Significance, Central Tendency, Dispersion, Correlation: Linear and Partial, Regression: Simple and Multiple Regression, Skewness, Time series Analysis, Index Number.
Testing of Hypothesis: T-test, Z- test, Chi Square, F-test, ANOVA.

UNIT – IV (11 Hrs.)

Multivariate Analysis: Factor Analysis, Discriminant Analysis, Cluster Analysis, Conjoint Analysis, Multi-Dimensional Scaling.
Report Writing: Essentials of Report Writing, Report Format.
Statistical Software: Application of Statistical Software like SPSS, MS Excel, Mini Tab or MATLAB Software in Data Analysis.
**Each Student has to Prepare Mini Research Project on Topic/ Area of their Choice and Make Presentation. The Report Should Consists of Applications of Tests and Techniques Mentioned in The Above UNITs.*

Recommended Books

1. R.I. Levin and D.S. Rubin, 'Statistics for Management', 7th Edn., Pearson Education New Delhi.
2. N.K. Malhotra, 'Marketing Research–An Applied Orientation', 4th Edn., Pearson Education New Delhi.
3. Donald Cooper, 'Business Research Methods', Tata McGraw Hill, New Delhi.
4. Sadhu Singh, 'Research Methodology in Social Sciences', Himalaya Publishers.
5. Darren George & Paul Mallery, 'SPSS for Windows Step by Step', Pearson Education New Delhi.
6. C.R. Kothari, 'Research Methodology Methods & Techniques', 2nd Edn., New Age International Publishers.

PARALLEL COMPUTING

Subject Code: MITE2-368 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

UNIT-I (10 Hrs.)

Introduction: Paradigms of parallel computing: Synchronous - vector/array, SIMD, Systolic; Asynchronous - MIMD, reduction paradigm.

UNIT-II (11 Hrs)

Hardware Taxonomy: Flynn's classifications, Handler's classifications. Software taxonomy: Kung's taxonomy, SPMD. Abstract parallel computational models: Combinational circuits, Sorting network, PRAM models, Interconnection RAMs. Parallelism approaches - data parallelism, control parallelism.

UNIT-III (12 Hrs.)

Performance Metrics: Laws governing performance measurement, Metrics- speedups, efficiency, utilization, communication overheads, single/multiple program performances, bench marks. Theoretical Models: Taxonomy and topology - shared memory multiprocessors, distributed memory networks. Processor organization - Static and Dynamic interconnections, Embedding and simulations.

UNIT-IV (12 Hrs.)

Parallel Programming: Shared Memory Programming, Distributed memory programming, Object oriented programming, Data parallel programming, functional and dataflow programming. Scheduling and Parallelization: Scheduling parallel programs. Loop scheduling. Parallelization of sequential programs, Parallel programming support environments

Recommended Books

1. M.J. Quinn, 'Parallel Computing: Theory and Practice', McGraw Hill, New York.
2. T.G. Lewis and H. El-Rewini, 'Introduction to Parallel Computing', Prentice Hall, New Jersey.
3. T.G. Lewis, 'Parallel Programming: A Machine-Independent Approach', IEEE Computer Society Press, Los.

DIGITAL IMAGE PROCESSING

Subject Code: MITE2-369 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

UNIT-I (10 Hrs.)

Fundamental of image processing: Introduction, Origin, Areas of Image Processing, steps in Digital Image Processing, Components of Image Processing System, Image Sensing, Sampling and Quantization, Neighbouring of Pixels

UNIT-II (11 Hrs.)

Image Enhancement and Restoration: Enhancement: Spatial Filtering, Introduction to Fourier Transformation Restoration: A model of the Image Degradation/ Restoration Process. Color Image Processing**:** Color fundamentals, models, transformation and segmentation, Noise in color Images.

UNIT-III (12 Hrs.)

Wavelets: Wavelet functions, Wavelet transformations in one and two dimensions, fast wavelet transform. Image Compression: Image compression models, Error free compression, Lossy compression. Image segmentation**:** Line detection, edge detection, Edge linking and boundary detection, region based Segmentation.

UNIT-IV (12 Hrs.)

Representation and Description: Representation, Boundary and Regional Descriptors, Relational Descriptors. Object Recognition**:** Pattern and pattern classes, recognition based on Decision Theoretic Methods, Structural Methods.

Recommended Books

Rafael C. Gonzalez, Richard E. Woods, 'Digital Image Processing' Addison-Wesley Pub (Sd).

SOFT COMPUTING

Subject Code: MITE2-370 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

UNIT-I (11 Hrs.)

Module I - Introduction - What is soft computing? Differences between soft computing and hard computing, Soft Computing constituents, Methods in soft computing, Applications of Soft Computing

Module II - Introduction to Genetic Algorithms- Introduction to Genetic Algorithms (GA), Representation, Operators in GA, Fitness function, population, building block hypothesis and schema theorem.; Genetic algorithms operators- methods of selection, crossover and mutation, simple GA(SGA), other types of GA, generation gap, steady state GA, Applications of GA

UNIT-II (12 Hrs.)

Module III - Neural Networks- Concept, biological neural system. Evolution of neural network, McCullochPitts neuron model, activation functions, feedforward networks, feedback networks, learning rules – Hebbian, Delta, Perceptron learning and Windrow-Hoff, winner-take-all.

Module IV - Supervised learning- Perceptron learning, single layer/multilayer perceptron, linear separability, hidden layers, back propagation algorithm, Radial Basis Function network; Unsupervised learning - Kohonen, SOM, Counter-propagation, ART, Reinforcement learning, adaptive resonance architecture, applications of neural networks to pattern recognition systems such as character recognition, face recognition, application of neural networks in image processing.

UNIT-III (12 Hrs)

Module V: Fuzzy systems - Basic definition and terminology, set-theoretic operations, Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions, Fuzzy Rules & Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making; Neuro-fuzzy modeling- Adaptive Neuro-Fuzzy Inference Systems, Coactive Neuro-Fuzzy Modelling, Classification and Regression Trees, Data Clustering Algorithms, Rulebase Structure Identification and Neuro-Fuzzy Control , Applications of neuro-fuzzy modelling.

UNIT-IV (10 Hrs)

Module VI: Swarm Intelligence- What is swarm intelligence? Various animal behavior which have been used as examples, ant colony optimization, swarm intelligence in bees, flocks of birds, shoals of fish, ant-based routing, particle swarm optimization

Recommended Books

1. S.N. Shivanandam, 'Principle of Soft Computing', Wiley. ISBN13: 9788126527410, **2011.**
2. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, 'Neuro-Fuzzy and Soft Computing', Prentice Hall of India, **2003**.
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. Mitchell Melanie, 'An Introduction to Genetic Algorithm', Prentice Hall, **1998**.
6. David E. Goldberg, 'Genetic Algorithms in Search, Optimization & Machine Learning', Addison Wesley, **1997**.