UNIVERSITY OF PUNE

Board of Studies in Mathematics

M.Sc. Tech. Industrial Mathematics with Computer Applications

SYLLABUS

Part-II

Sem-III

MIM-301: Numerical Analysis
MIM-302: Software Engineering (OOSE)
MIM-303: Object Oriented Programming in JAVA
MIM-304: Operating Systems
MIM-305: Theoretical Computer Science
MIM-306: Lab Course based on MIM 303 and MIM 304

Sem-IV

MIM-401: Topology
MIM-402: Networking
MIM-403: Web Technologies (Client and Server side)
MIM-404: Design and Analysis of Algorithms
MIM-405: Elective I
MIM-406: Project course

ELECTIVES

MIM-405 Electives (Departmental Course)

Any one of:

(A) Measure and Integration
(B) Statistical and Numerical Methods
(C) Cryptography and Network Security
(D) Soft Computing-I
(Fuzzy Logic and Neural Networks)
(E) Computer Graphics
(F) Data Mining & Warehousing
(G) Topics in Comp. Maths-I
(H) Emerging Tech-I

UNIVERSITY OF PUNE

Board of Studies in Mathematics

M.Sc. Tech. Industrial Mathematics with Computer Applications

Detailed Syllabi of Courses

PART II : Semesters III and IV

MIM 301 Numerical Analysis (Semester III)

1. Iterative solutions of Nonlinear Equations : Bisection Method, Fixed-Point iteration, Newton's method, Secant method, Acceleration of convergence, Newton's method for two nonlinear equations, Polynomial equation methods.

2. Polynomial Interpolation : The Lagrange interpolation polynomial, Divided difference interpolation, Aitken's Algorithm, Finite difference formulas, Choice of nodes and non convergence of polynomial interpolation.

3. Systems of Linear equations : Gauss elimination with partial pivoting, Error analysis, Matrix factorization methods (Doolittle reduction, crout reduction), Iterative refinement, Iterative techniques, Guess-Seidel iteration Acceleration and successive overrelaxation.

4. Numerical Calculus : Numerical differentiation, Forward difference Quotient, Central difference quotient, Interpolatory quadrature (order of methods), Newton-Cotes methods, Error estimates for trapezoidal rule and Simpson's rule.

5. Numerical solution of Differential Equations : Euler's method, Analysis of Euler's method, Order of Euler's method, Runge-Kutta method, One step modified and midpoint methods, Runde-Kutta methods for systems of equations.

6. The Eigen value problem : Power method, Gerschgorin Disk Theorem, Eigenvalues of symmetric matrices, Jacobi method, Householder transformation.

Reference Books :

1. John H. Mathews : Numerical Methods for Mathematics, Science and Engineering (Prentice-Hall) 2nd Edition.
   Sections : 1.3, 2.1 to 2.7, 3.4 to 3.7, 4.2 to 4.4, 6.1 to 6.2, 7.1 to 7.4, 9.2 to 9.7, 11.1 to 11.4

2. K.E. Atkinson : An introduction to numerical Analysis (John Wiley Sons).

3. James L. Buchanan and Peter R. Turner : Numerical Methods and Analysis (McGraw-Hill).

4. F.B. Hildebrand : Introduction to Numerical Analysis (Mc-Graw Hill - Indian Edition).

5. M.K. Jain, S.R. K. Iyengar, R.K. Jain : Numerical Methods for Scientific and Engineering Competition (Wiley Eastern Limited).

MIM 302 Software Engineering (OOSE) (Semester III)

1. Introduction [4]
   1.1. Software, attributes of good software

Software Engineering
Software process
Challenges facing software engineering.

2. Socio-technical systems [4]

System, System properties
System Engineering
Critical systems,
System dependability, availability, reliability, safety and security

3. Software processes [4]

Software process models
Process iteration
Process activities

4. Software Requirements [4]

Functional and nonfunctional requirements
User requirements
Software requirements document
Requirements engineering
Feasibility studies, elicitation and analysis
4.5 Requirements validation

5. System Models [4]

Context models
Behavioral models
Data models

6. Distributed Systems Architectures [4]

Client server architectures
Distributed object architectures

7. Object Oriented Design [6]

Objects and Object Classes
An object oriented design process
Design Evolution

8. User Interface Design [4]

Design Issues
UI Design Process

User Analysis
User Interface Prototyping
Interface Evaluation

9. Rapid software Development [4]
Agile methods
Extreme programming
Rapid application development

10. Verification and validation [4]
Verification and validation
Software Inspections
Automated static analysis
Verification and formal methods

11. Software testing [4]
System testing
Component testing
Test case design
Test automation

Reference Books:

1. Software Engineering (7th Edition) – by Ian Sommerville – Pearson education
2. Software Engineering – A Practitioner's Approach 6th, 7th Edition – Roger S. Pressman [McGraw Hill International Edition]

MIM 303 Object Oriented Programming in Java (Semester III)

1. Introduction to Object Oriented Concepts [2]
   1.1. Object, Class
   1.2. Encapsulation, Abstraction, Data Hiding, Inheritance, Polymorphism,
   1.3. Message Passing, Dynamic binding
   1.4. History of Object Oriented languages
   1.5. Comparison with structured programming.

2. Introduction to The Java Technology [2]
   2.1. The Java platform, Java buzzwords, API, JVM
   2.2. Java compiler, bytecodes
   2.3. java editions

3. Main features of Java language [3]
   3.1. Introduction to Java, Writing & compiling Java programs- the main method
   3.2. Command line arguments, **String** class, Primitive data types, Variables and assignment, javadoc comments
   3.3. Expressions, Data conversion, Interactive programs, Boolean data type and expressions,
   { If, Switch } statements, { For, While, Do } statements, Creating, calling methods, Parameter passing, Returning values, Overloading methods, Scope of variables.
4. Arrays [3]
   4.1. Defining and initializing arrays, new operator, using arrays
   4.2. passing arrays to methods, returning arrays from methods
   4.3. command-line arguments
   4.4. 2-dimensional arrays

5. Objects and Classes [4]
   5.1. Defining Class, Creating object, reference variables,
   5.2. Visibility modifiers – public, private, protected
   5.3. Object members and class members (static), Arrays of objects, **this** keyword, **Wrapper** Classes

6. Packages and Interfaces [4]
   6.1. Concept of package, Package and import keywords
   6.2. Concept of interfaces, Implementing interfaces
   6.3. Use of predefined packages
   6.4. Use of predefined interfaces – Comparable and Comparator

7. Inheritance and Polymorphism [6]

7.1. Superclass and Subclass – **extends** keyword, **super** keyword, Overriding members
7.2. Protected data members- Object Class and its toString() method, **Abstract** Classes
7.3. Final classes, methods and variables, instanceof operator
7.4. dynamic binding , Casting objects

8. Exceptions and Exception handling [4]
   8.1. Exception class hierarchy
   8.2. Checked and unchecked exceptions
   8.3. Try, catch, throw, throws finally keywords
   8.4. Creating user defined exceptions.

9. Text and File I/O [3]
   9.1. Predefined I/O classes
   9.2. Simple I/O operations using console and files
   9.3. The File class

10. GUI and Event Handling using Java [10]
    10.1. Introduction to AWT and Swing
    10.2. Creating containers and components (JFrame, JPanel, JButton, JTextField, JCheckBox, JRadioButton, JMenu, JList, JTable)
    10.3. Layout Managers
    10.4. Delegation event model - Event sources, event listeners, event classes.

11. JDBC [5]
    11.1. The Design of JDBC
    11.2. The Structured query language
    11.3. Basic JDBC programming concepts
    11.4. Query Execution
    11.5. Scrollable and updatable result sets.

12. Introduction to collections [2]
    12.1. Concrete Collections
        12.1.1. Linked List
        12.1.2. Array Lists
        12.1.3. Hash Sets
        12.1.4. Tree Sets
        12.1.5. Maps

Reference Books:

1. Java : How to Program, Deitel & Deitel, Prentice Hall
2. Core Java 2: Volume I – Fundamentals, Cay S. Horstmann and Gary Cornell; Prentice-Hall 2002. ISBN 0130471771
3. Core Java 2: Volume II – Advanced Features, Cay S. Horstmann and Gary Cornell; Prentice-Hall 2001. ISBN 0130927384
4. Java: The Complete Reference, Herbert Schildt. Fifth Edition
5. Introduction to Java Programming, Daniel Liang

Important URLs : http://java.sun.com/reference/docs/

MIM-304 Operating Systems

1) Introduction of Operating system [6]

   1.1. What do Operating Systems do?
   1.2. Operating system structure
   1.3. Operating system operations
   1.4. Process management
   1.5. Memory management
   1.6. Storage management
   1.7. Operating system services
   1.8. User operating system Interface
   1.9. System calls : types of system calls
   1.10. System programs: types of system programs, shell as a system program.

2) File System [6]
   2.1. File Concept : File types, File operations
   2.2. Access methods
   2.3. Directory structure : Device directory contents ,Operations
   2.4. Protection
   2.5. File system structure
   2.6. Allocation methods
   2.7. NFS

3) CPU scheduling [5]
   3.1. Process-concept : process state, PCB
   3.2. Operations on processes
   3.3. Scheduling concepts
   3.4. Scheduling queues
   3.5. Schedulers
   3.6. Scheduling criteria
   3.7. Scheduling algorithms
   3.8. Multiple processor scheduling

4) Deadlocks [5]
   4.1. System model
   4.2. Deadlock characterization
   4.3. Methods of Handling Deadlocks
   4.4. Deadlock prevention
   4.5. Deadlock avoidance
   4.6. Deadlock detection
   4.7. Recovery from deadlock

5) Threads [4]
   5.1. Overview
   5.2. Multithreading models
   5.3. Threading Issues
   5.4. Pthreads
   5.5. Java Threads

6) Process Synchronization [6]
   6.1. Background
   6.2. The critical-section problems
   6.3. Peterson's solution
   6.4. Synchronization Hardware
   6.5. Semaphores
   6.6. Classic Problems of Synchronization

7) I/O System [4]
   7.1. Overview
   7.2. I/O hardware
   7.3. Application I/O Interface
   7.4. Kernel I/O Subsystem

8) Memory management [8]
   8.1. Background
   8.2. Logical Vs Physical address space
   8.3. Swapping
   8.4. Contiguous allocation
   8.5. Paging
   8.6. Segmentation
   8.7. Segmentation with paging – Combined system
   8.8. Virtual memory concept – Overlays, Demand paging, Page replacement algorithms.

Reference Books :

2. Operating System principles – A. Silberschatz, P. Galvin, G. Gagne
3. Modern Operating system by Tanenbaum , PHI Publication

MIM-305 Theoretical Computer Science (Semester III)

1. Preliminaries
   - 1.1. Sets, operations on sets, finite and infinite sets.
   - 1.2. Symbol, alphabet, string, prefix and suffix of strings.
   - 1.3. Formal language.

2. Formal languages
   - 2.1. Chomsky hierarchy
   - 2.2. Validating machines for languages
   - 2.3. Kleene closure and positive closure
   - 2.4. Operations on languages (Union, Intersection and Concatenation)

3. Regular Languages
   - 3.1. Regular Expressions : Definition, example and identities.
   - 3.2. Finite automata : concept
   - 3.3. DFA : definition and examples.
   - 3.4. NFA : definition and examples.
   - 3.5. Language accepted by FA and NFA with Є moves.
   - 3.6. Regular Expression to FA : method and problems.
   - 3.7. NFA to DFA : method and problems.
   - 3.8. Minimization of DFA : problems using table methods.
   - 3.9. FA with output : moore and mealy machines. : Definition and their equivalence.
   - 3.10. Applications of FA : Pumping lemma and examples.
   - 3.11. Closure Properties : Union, Intersection, Concatenation, Complement and Kleene closure

4. Context free languages
   - 4.1. CFG : Definition and examples.
   - 4.2. Ambiguous grammar : concept and example.
   - 4.3. Simplification of CFG : removing useless symbols, removing unit productions and removing nullable symbols : method and problems.
   - 4.4. Normal forms : CNF and GNF : method and problems.
   - 4.5. Regular grammar : definition equivalence of FA and regular grammar.
   - 4.6. PDA : Basic concept, definition, DPDA and NPDA.
   - 4.7. Construction of PDA using empty stack and final state method : examples using stack method.
   - 4.8. Equivalence between acceptance by final state and empty stack method and examples.
   - 4.9. Equivalence between PDA and CFG (in GNF) : method and examples

5. Properties of CFL
   5.1. Pumping Lemma for CFL : methods and problems
   5.2. Closure properties of CFL's : Union, Concatenation and Kleene closure : methods and examples

6. Turing Machines
   6.1. Recursive and recursively enumerable languages
   6.2. Introduction to LBA (Basic model) and CSG.
   6.3. Definition of TM
   6.4. Basic Model
   6.5. Design of TM for language recognition
   6.6. Types of TM (Multitape TM, NonDeterrministic TM, Universal TM, Restricted TM).
   6.7. Undecidable Problem, Halting Problem of TM

Reference Books:

1. Languages and Machines – Thomas A. Sudkamp – Third Edition
2. Introduction to Automata theory, languages and computation – John E. Hopcroft, Jeffery D. Ullman.
3. Introduction to Computer Theory – Daniel I.A. Cohen
4. Principles of Compiler Design – Alfred V. Aho, Jeffery D. Ullman.
5. Theory of Computer Science (Automata languages and computation) – K. L. P. Mishra and N. Chandrasekharan
6. Introduction to languages and theory of Computation – John C. Martin.

MIM-401 Topology (Semester IV)

1. Definition and examples of topological spaces. Closed sets. Closure. Dense subsets. Neighbourhoods. Interior. Exterior and Boundary. Accumulation Points and derived sets. Bases and sub-bases. Subspaces and relative topology.

2. Continuous functions and homeomorphism.

3. First and Second Countable Spaces. Lindelof Spaces. Separable spaces. Second Countability and Separability.

4. Separation axioms, their Characterizations and basic properties. Urysohn's Lemma.

5. Compactness. Continuous functions and Compact sets. Basic properties of Compactness Compactness and finite intersection property. Sequentially and countably compact sets. Local compactness and one point compactification. Compactness in metric spaces. Equivalence of Compactness. Countable Compactness and Sequential Compactness in metric spaces. Statement of Tychonoff's Theorem.

6. Connected spaces. Connectedness on the real line. Components.

Reference:

1. Topology, A First Course, J.R. Munkres, Prentice Hall of India Pvt. Ltd.
2. Basic Topology, Armstrong, Springer Verlag (Indian Edn)
3. Topolgy, K.D.Joshi.

MIM 402 – Computer Networks (Semester IV)

1. Network Models [2]
   - 1.1. Reference Models
     - 1.1.1. The OSI Reference Model
     - 1.1.2. TCP/IP Reference Model
     - 1.1.3. Comparison of the OSI and TCP/IP reference models

   – Book 1 chap 1, unit 1.4.

2. Physical Layer [10]
   - 2.1. Tasks Performed – Book 2, Pg 45-47
   - 2.2. Signals
     - 2.2.1. Analog and Digital
     - 2.2.2. Analog signals
     - 2.2.3. Digital signals

     – Book 2, Chapter 3, Units 3.1 – 3.3
   - 2.3. Digital Transmission
     - 2.3.1. Line coding
       - 2.3.1.1. Some characteristics of Line coding
       - 2.3.1.2. Line coding scheme

       – Book 2, chapter 4, Unit 4.1, pages 85-93.
   - 2.4. Sampling
     - 2.4.1. PAM
     - 2.4.2. PCM

     – Book 2, chapter 4, Unit 4.3, Pages 98-101
   - 2.5. Transmission Mode
     - 2.5.1. Parallel Transmission
     - 2.5.2. Serial Transmission

     – Book 2, chapter 4, Unit 4.4
   - 2.6. Transmission Media
     - 2.6.1. Guided Media
     - 2.6.2. Unguided Media (Wireless)

     – Book 2, chapter 7, Units 7.1, 7.2
   - 2.7. The Public Switched Telephone Network
     - 2.7.1. Structure of the telephone Network
     - 2.7.2. Switching – Circuit, Message and Packet

     – Book 1, Chapter 2, Unit 2.5.1 and 2.5.5

3. Data Link Layer [8]
   - 3.1. Data Link Layer Design Issues
     - 3.1.1. Services provided to the network layer
     - 3.1.2. Framing
     - 3.1.3. Error control
     - 3.1.4. Flow control

     – Book 1, chapter 3, unit 3.1

3.2. Error Detection and Correction
  3.2.1. Types of Errors – Single bit and burst errors
  3.2.2. Detection
  3.2.3. Error Correction
  – Book 2, chapter 10, Units 10.1 – 10.3
3.3. Elementary Data Link Protocols
  3.3.1. Unrestricted Simplex protocol
  3.3.2. A simplex stop- and – wait protocol
  3.3.3. A simplex protocol for a noisy channel
  – Book 1, chapter 3, Unit 3.3
3.4. Sliding Window protocols
  3.4.1. One-bit sliding window protocol
  3.4.2. A protocol using Go Back N
  3.4.3. A protocol using Selective Repeat
  – Book 1, chapter 3, Unit 3.4

4. The Medium Access Sublayer [8]
4.1. The Channel Allocation Problem
  4.1.1. Static Channel Allocation in LANs and MANs
  4.1.2. Dynamic channel allocation in LANs and MANs.
  – Book 1, chapter 4, unit 4.1
4.2. Multiple Access
  4.2.1. Random Access
  4.2.2. Controlled Access
  4.2.3. Channelization – FDMA, TDMA, CDMA concepts
  – Book 2, chapter 13, Units 13.1 – 13.3, Pages 320-321
4.3. Local Area Networks : Ethernet
  4.3.1. Traditional Ethernet
  4.3.2. Fast Ethernet
  4.3.3. Gigabit Ethernet
  – Book 2, chapter 14, Unit 14.1 – 14.3
4.4. Data Link Layer Switching
  4.4.1. Bridges from 802.x to 802.y
  4.4.2. Local Internetworking
  4.4.3. Spanning tree Bridges
  4.4.4. Remote Bridges
  4.4.5. Repeaters, Hubs, Bridges, Switches, Routers and Gateways
  4.4.6. Virtual LANs.
  – Book 1, chapter 4, Unit 4.7
4.5. Wireless LANs
  4.5.1. IEEE 802.11 Architecture: BSS and ESS, Station types
  4.5.2. Bluetooth – Architecture : Piconets and scatternet
  - Book 2, chapter 15, Unit 15.1, Page 361-363 and Unit 15.2, Page 372-374

5. Network Layer [12]

5.1. Network Layer Design Issues
    5.1.1. Store and Forward Packet Switching
    5.1.2. Services Provided to the Transport Layer
    5.1.3. Implementation of Connectionless Services
    5.1.4. Implementation of Connection oriented services
    5.1.5. Comparison of Virtual Circuit and Datagram Subnets
    – Book 1, chapter 5, unit 5.1
5.2. Addressing
    5.2.1. Internet Address
    5.2.2. Classful Address
    5.2.3. Subnetting
    5.2.4. Classless Addressing
    5.2.5. Dynamic Address Configuration
    – Book 2, chapter 19, Units 19.2
5.3. Routing Algorithms
    5.3.1. Optimality Principle
    5.3.2. Shortest Path Routing
    5.3.3. Flooding
    5.3.4. Distance Vector Routing
    5.3.5. Link State Routing
    - Book 1, Chapter 5, Unit 5.2.1 – 5.2.5
    5.3.6. Routing Techniques – Routing Table
        5.3.6.1. Next hop Routing
        5.3.6.2. Network specific Routing
        5.3.6.3. Host specific routing
        5.3.6.4. Default Routing
    5.3.7. Static versus Dynamic Routing Table
    5.3.8. Routing Table for Classful Addressing
    – Book 2, chapter 19, Unit 19.1
5.4. Congestion Control
    5.4.1. Concept
    5.4.2. General Principles of Congestion Control
    5.4.3. Congestion Control Prevention Policies
     – Book 1, chapter 5, Unit 5.3,5.3.1,5.3.2
5.5. Internetworking
    5.5.1. How networks Differ
    - Book 1, chapter 5, Unit 5.5.1
5.6. Network Layer Protocols
    5.6.1. ARP
    5.6.2. IP
    5.6.3. ICMP
    - Book 2, chapter 20, Unit 20.1-20.3

6. Transport Layer [6]
   6.1. The Transport Service
      6.1.1. Services provided to the Upper layers
      6.1.2. Transport Service primitives
      – Book 1, chapter 6, unit 6.1.1, 6.1.2
   6.2. Elements of Transport Protocols
      6.2.1. Addressing
      6.2.2. Connection Establishment
      6.2.3. Connection Release
      6.2.4. Flow Control and Buffering
      6.2.5. Multiplexing
      6.2.6. Crash Recovery
      – Book 1, chapter 6, Unit 6.2 Pages 492 - 513
   6.3. The Internet Transport Protocols : UDP
      6.3.1. Introduction to UDP
      6.3.2. Remote Procedure Call
      – Book 1, chapter 6, Units 6.4.1, 6.4.2
   6.4. The Internet Transport Protocols : TCP
      6.4.1. Introduction to TCP
      6.4.2. The TCP Protocol
      6.4.3. The TCP Segment Header
      – Book 1, chapter 6, Units 6.5.1, 6.5.3, 6.5.4

7) Upper Layer Protocols [2]
   7.1 SMTP, FTP, Telnet, HTTP (functionality and applications only)

Reference Books

1. Computer Networks , A. S. Tanenbaum, 4th Edition
2. Data Communication and Networking, Behrouz Forouzan, 3rd Edition

MIM 403 Web Technologies (Semester IV)

1. Fundamentals [2]
   - 1.1. Introduction to Internet
   - 1.2. WWW
   - 1.3. Web browser
   - 1.4. Web Server
   - 1.5. Uniform Resource Locator
   - 1.6. Multipurpose Internet Mail Extensions
   - 1.7. HTTP

2. Introduction to HTML [4]
   - 2.1. Origin and evolution of HTML
   - 2.2. Basic Syntax, Basic Text Markup
   - 2.3. Images
   - 2.4. Hyperlinks
   - 2.5. Lists
   - 2.6. Tables
   - 2.7. Forms
   - 2.8. Frames

3. Client side programming using JavaScript [8]
   - 3.1. Overview of JavaScript
   - 3.2. Object Orientation and JavaScript
   - 3.3. Basic Syntax
   - 3.4. Primitives, Operations and Expressions
   - 3.5. Screen output and keyboard input
   - 3.6. Control Statements
   - 3.7. Object creation and modification
   - 3.8. Arrays, functions
   - 3.9. Constructors
   - 3.10. Pattern Matching using regular expressions

4. Server side scripting using Perl [8]
   - 4.1. Origins and uses of Perl
   - 4.2. Scalars and their operations
   - 4.3. Assignment statement and simple input output
   - 4.4. Control statements
   - 4.5. Fundamentals of Arrays
   - 4.6. Hashes
   - 4.7. References
   - 4.8. Functions
   - 4.9. Pattern matching
   - 4.10. File I/O

5. Using Perl for CGI programming [4]
   5.1. Introduction to CGI
   5.2. CGI linkage
   5.3. Query String Format
   5.4. CGI.PM Module
   5.5. Cookies

6. Introduction to PHP [6]
   6.1. Origins and uses of PHP
   6.2. Overview of PHP
   6.3. Basic Syntax
   6.4. Primitives, Operations and expressions
   6.5. Output
   6.6. Control Statements
   6.7. Arrays, Functions
   6.8. Pattern Matching
   6.9. Form Handling
   6.10. Files

7. Introduction to XML [8]
   7.1. Introduction
   7.2. Syntax
   7.3. XML Document structure
   7.4. Document type definition
   7.5. Namespaces
   7.6. XML Schemas
   7.7. Displaying raw XML documents
   7.8. Displaying XML documents with CSS
   7.9. XSLT style sheets
   7.10. XML processor

8. Servelets [8]
   8.1. Overview of Servlets :background
   8.2. Servlet details: life cycle,
   8.3. Servlet API
   8.4. The JavaX.servlet package
   8.5. Reading servlet parameters
   8.6. JavaX.Servlet.http package
   8.7. Handling http request and responses
   8.8. Using cookies
   8.9. Session tracking.

Reference Books:

1. Programming the World Wide Web – Robert W. Sebesta (3rd Edition)
2. Java the complete reference – Herbet Schildt 7th edition.

MIM 404 Design and Analysis of Algorithms- I (Semester IV)

1. Mathematical Foundation [8]
   1.1. Growth functions
   1.2. Summations
   1.3. Recurrences Substitutions, iterations, master methods
   1.4. Amortized Analysis

2. Sorting [6]
   2.1. Heap Sort
   2.2. Quick Sort
   2.3. Merge Sort
   2.4. Sorting in linear time

3. Dynamic Programming [8]
   3.1. Matrix chain multiplication, longest common subsequence, optimal polygon triangulation

4. Greedy Algorithm [4]
   4.1. An activity selection problem
   4.2. Elements of the greedy strategy
   4.3. Hauffman codes

5. Graphs [10]
   5.1. Traversals, topological sort
   5.2. Minimum spanning trees
   5.3. Single source shortest Path : Dijkstra's & Bellman Ford Algorithm
   5.4. All Pair shortest path
   5.5. Maximum flow problems

6. NP-completeness [8]
   6.1. Polynomial time
   6.2. Polynomial time verification.
   6.3. NP-completeness and reducibility.
   6.4. NP-completeness proofs
   6.5. NP-completeness problems.

7. Approximation algorithms [4]
   7.1. The vertex-cover problem
   7.2. the traveling salesman problem

Reference Books

1. Introduction to Algorithms - T.H. Coremen, C.E. Leiserson, R.L. Rivest Prentice Hall India

MIM 405: C : Cryptography and Network Security
(Semester IV)

1. Conceptual foundation of Information Systems Security: [4]
   1.1. Concepts and Terminology: Threats, Attacks, Vulnerabilities, Risks, Risk Assessment and Mitigation,
   1.2. Security – Confidentiality, Integrity, Availability, Identification, Authentication, Authorization, Accountability, Privacy

2. Cryptography: [2]
   2.1. Techniques
   2.2. Mathematical foundation
   2.3. Stream Ciphers
   2.4. Block Ciphers
   2.5. Cryptanalysis.

3. Symmetric / Secret Key Encryption [6]
   3.1. Algorithm Types and Modes
   3.2. DES (Data Encryption Standard)
   3.3. Double DES
   3.4. Triple DES
   3.5. AES (Advanced Encryption Standard)
   3.6. IDEA (International Data Encryption Algorithm)
   3.7. Blowfish
   3.8. RC5

4. Public Key Encryption [8]
   4.1. Principles of public key crypto-systems
   4.2. mathematical foundation
   4.3. RSA algorithm
   4.4. key management
   4.5. Deffie-Hellman key exchange
   4.6. Elliptic curve cryptography
   4.7. Digital Signatures using DSA (Digital Signature Algorithm)
   4.8. DSS (Digital Signature Standard)
   4.9. RSA

5. Message Integrity techniques [2]
   5.1. MD5
   5.2. SHA

6. PKI [3]
   6.1. Public Key Infrastructure and Trust Hierarchy
   6.2. Digital Certificates
   6.3. transaction certificates

7. Authentication techniques: [4]
   7.1. passwords, pass-code, pass-phrase
   7.2. challengeresponse, biometrics-based registration and authentication,
   7.3. Kerbores

8. Internet Security protocols [6]
   8.1. SSL/TLS
   8.2. TSP
   8.3. SET
   8.4. 3 – D Secure protocol
   8.5. Electronic money
   8.6. email security (PGP, PEM, S/MIME)

9. IP Security [4]
   9.1. IPSec
   9.2. VPN

10. Server Security [6]
    10.1. Concepts
    10.2. Design and Implementation of Firewalls
    10.3. Intrusion Detection Systems (IDS)
    10.4. Intrusion Prevention Systems (IPS)

11. Virus Threats including Network Viruses, Worms [2]

12. Data Hiding and Steganography [1]

Reference Books :

1. Atul Kahate," Cryptography And Network Security" TMH

2. William Stallings," Cryptography And Network Security" Prentice Hall / Pearson Education

MIM 405: D: Soft Computing - I (Semester IV)
Fuzzy Logic and Neural Networks

1. Foundations of Fuzzy Systems [8]
   - 1.1. From Crisp to Fuzzy Sets
   - 1.2. Representing Fuzzy Elements
   - 1.3. Basic Terms and Operations
   - 1.4. Properties of Fuzzy sets
   - 1.5. Fuzzy Measures
   - 1.6. Fuzzification
   - 1.7. Fuzziness and Probability Theory
   - 1.8. Membership Function Shape Analysis
   - 1.9. The Extension Principle
   - 1.10. Alph-cuts and the Resolution Principle

2. Fuzzy Relations [4]
   - 2.1. Composition of Fuzzy Relations

3. Arithmetic Operations of Fuzzy Numbers [3]
   - 3.1. The alpha-cut method
   - 3.2. The Extension Principle Method

4. Linguistic Descriptions and their Analytical Forms [4]
   - 4.1. Fuzzy linguistic descriptions
   - 4.2. Fuzzy Relation Inferences
   - 4.3. Fuzzy Implication and Fuzzy Algorithms

5. Defuzzification Methods [2]
   - 5.1. Centre of Area Defuzzification
   - 5.2. Centre of Sums Defuzzification
   - 5.3. Mean of Maxima (MOM) Defuzzification

6. Fuzzy Logic in Control and Decision Making Applications [3]
   - 6.1. Fuzzy Controllers
   - 6.2. Fuzzy Decision Making

7. Artificial neurons, neural network and architecture [3]
   - 7.1. Neuron abstraction
   - 7.2. Neuron signal functions
   - 7.3. Architectures: feedforward and feedback
   - 7.4. Salient properties and application domains of neural networks

8. Geometry of binary threshold neurons and their networks [3]
   - 8.1. Pattern recognition and data classification

8.2. Convex sets, convex hulls and linear separability
8.3. Space of Boolean functions
8.4. Pattern Dichotomizers
8.5. Capacity of a simple threshold logic neuron
8.6. XOR problem
8.7. Multiplayer networks

9. Perceptrons and LMS [8]
   9.1. Learning and memory
   9.2. From synopses to behaviour
   9.3. Learning algorithms
   9.4. Error correction and gradient descent rules
   9.5. The learning objectives for TLNs
   9.6. Pattern space and weight space
   9.7. Perceptron learning algorithm
   9.8. Perceptron convergence algorithm
   9.9. Perceptron learning and Non-separable sets
   9.10. alpha-Least Mean Square Learning
   9.11. MSE Error Surface and its Geometry
   9.12. Steepest Descent Search with Exact Gradient Information
   9.13. Mue-LMS : Approximate Gradient Descent

10. Backpropagation [6]
   10.1. Multilayered Network Architecture
   10.2. Backpropagation Learning Algorithm
   10.3. Practical Considerations in implementing BP algorithm
   10.4. Structure Growing Algorithms
   10.5. Fast relatives of Backpropagation
   10.6. Universal Function Approximation
   10.7. Applications of Feed forward Neural Networks

11. Attractor Neural Networks [4]
   11.1. Associative Learning
   11.2. Hopfield Network

Reference Books:

1. Fuzzy Sets and Fuzzy Logic, Theory and Applications, George.J.Klir, Bo Yuan; PHI, 2005.
2. Fuzzy Sets, Uncertainty and Information, George J.Klir, Tina A.Folger, PHI, 2005 Edition 2005.
3. Fuzzy Logic with Engineering Applications – Timothy J. Ross
4. Neural Networks, A Classroom Approach, Satish Kumar, Tata McGraw-Hill Publishing Company Limited, ISBN : 0-07-048292-6
5. Artificial Neural Networks by Kishan Mehrotra, Chilkuri K. Mohan, Sanjay Ranka, Penram International Publishing (India), ISBN : 81-900828-3-3
6. Neural Networks, A Comprehensive Foundation by Simon Haykin, Pearson Education, ISBN : 81-7758-852-4

MIM 405: E : Computer Graphics
(Semester IV)

1) Input / Output Devices
   - 1.1 Light pens, Joystics, Digitilizers.
   - 1.2 Refreshing Display Devices
   - 1.3 Random and Raster scan display devices
     (Book 2 : Chapter 1, First Edition)

2) Line generation and Area filling Algorithms
   - 2.1 Bresenham line generation algorithms.
   - 2.2 Scan Line
   - 2.3 Flood fill and Boundary fill algorithms for polygon domains.
     (Book 2: Chapter 6, for Cyrus – Beck Algorithm – Book 3: article 3.5)

3) Line Clipping Algorithms
   - 3.1 Cohen – Sutherland algorithm
   - 3.2 Cyrus – Beck Algorithm
   - 3.3 Liang – Barsky Algorithm
     (Book 1 : Chapter 2 or Book 2 : Chapter 5)

4) Transformation into 2.D
   - 4.1 Translation, rotation, scaling and shearing transformation
   - 4.2 Reflection about any arbitrary line.
   - 4.3 Homogenous Coordinates
     (Book 1: Chapter 2 or book 2: Chapter 5)

5) Projections
   - 5.1 Parallel projection, Isometric projection
   - 5.2 Cabinet and Cavelier Oblique projections
   - 5.3 Perspective projective
   - 5.4 Vanishing Points.
   - 5.5 1 – point and 2 point perspective projective (Book 1: Chapter 3 or book 2: Chapter 9)

6) Representing Curves & Surfaces
   - 6.1 Polygon Meshed
   - 6.2 Hemite & Bezier Cubic Curves
   - 6.3 B-Spline
   - 6.4 Uniform, Non Uniform , Open and non open B-splines
   - 6.5 Bicubic surface,patches
   - 6.6 Conditions for smooth joining of curves and surface patches

   (book 2 : chapter 10)

7) Hidden line/ surface elimination algorithms
   7.1 Z buffer algorithms
   7.2 Depth – sort algorithm
   7.3 Area subdivision method
   7.4 Floating horizon algorithm
   (Book 2: chapter 13, 13.1, 1 – 13.8)

Reference Books:

1) Mathematical Elements for Computer Graphics – Roger and Adams (McGraw Hill)
2) Computer Graphics C Version – Hearn and Baker (Pearson Education)
3) Procedural Elements for Computer Graphics – David Rogers (Tata Mcgraw Hill)

MIM 405: F : Data Mining and Data Warehousing
(Semester IV)

1. Introduction [8]
   - 1.1. Motivation and importance
   - 1.2. What is Data Mining?
   - 1.3. Data Mining on What Kind of Data?
   - 1.4. Data Mining Functionalities
   - 1.5. Are all of the Patterns Interesting?
   - 1.6. Classification of Data Mining Systems
   - 1.7. Data mining Task Primitives
   - 1.8. Integration of a Data Mining System with a Database or Data Warehouse System
   - 1.9. Major Issues in Data Mining

2. Data Preprocessing [8]
   - 2.1. Why Preprocess the Data?
   - 2.2. Descriptive Data Summarization
   - 2.3. Data Cleaning
   - 2.4. Data Integration and Transformation
   - 2.5. Data Reduction
   - 2.6. Data Discretization and Concept Hierarchy Generation

3. Data Warehouse and OLAP Technology : An Overview [6]
   - 3.1. What is a Data Warehouse?
   - 3.2. A Multidimensional Data Model
   - 3.3. Data Warehouse Architecture
   - 3.4. Data Warehouse Implementation
   - 3.5. From Data Warehousing to Data Mining

4. Mining Frequent Patterns, Associations, and Correlations [6]
   - 4.1. Basic Concepts and Road Map
   - 4.2. Efficient and Scalable Frequent Itemset Mining Methods
   - 4.3. Mining Various Kinds of Association Rules

5. Classification and Prediction [8]
   - 5.1. What is Classification? What is Prediction?
   - 5.2. Issues Regarding Classification and Prediction
   - 5.3. Classification by Decision Tree Induction
   - 5.4. Bayesian Classification
   - 5.5. Rule-Based Classification
   - 5.6. Classification by Backpropagation
   - 5.7. Support Vector Machines

5.8. Associative Classification : Classification by Association Rule Analysis
5.9. Lazy Learners (or Learning from Your Neighbors)
5.10. Other Classification Methods
5.11. Prediction

6. Cluster Analysis [8]
   6.1. What is Cluster Analysis?
   6.2. Types of Data in Cluster Analysis
   6.3. A Categorization of Major Clustering Methods
   6.4. Partitioning Methods
   6.5. Hierarchical Methods
   6.6. Density-Based Methods
   6.7. Grid-Based Methods
   6.8. Outlier Analysis

7. Mining Time-Series, and sequence Data [2]
   7.1. Mining Time-Series Data
   7.2. Mining Sequence Patterns in Transactional Databases

8. Mining Object, Spatial, Multimedia, Text, and Web Data [2]
   8.1. Mining the World Wide Web

Reference Books:

1. Data Mining Concepts and Techniques , J.Han and M. Kamber, 2nd edition
2. Data Mining, Introduction and Advanced Topics, Margaret H. Dunham and Sridhar, Pearson Education, ISBN 81-7758-785-4
3. Data Mining Techniques, Arun K Pujari, Universities Press (India) Limited, ISBN 81-7371-380-4
4. Data Mining, Pieter Adriaans & Dolf Zantinge: (pearson Education Asia), ISBN 81-7808-425-2. Addison Wesley Longman (Singapore)
5. Data Mining Techniques for Marketing, Sales and Customer Relationship Management, Michael J. A. Berry and Gordon S. Linoff, Wiley-Dreamtech India Pvt. Ltd., ISBN 81-265-0517-6

MIM 405: H : Emerging Technologies – I (.Net)
(Semester IV)

1. The philosophy of .Net [4]
   - 1.1. Introducing building blocks of the .Net Platform
   - 1.2. Overview of .Net Assemblies
   - 1.3. Role of CIL
   - 1.4. The role of .NET type metadata
   - 1.5. Assembly Manifest
   - 1.6. Understanding CTS, CLS, CLR

2. The C# Programming language [5]
   - 2.1. System.Console Class
   - 2.2. Method Parameter modifiers
   - 2.3. Value Types and Reference types
   - 2.4. Boxing and Unboxing Operations
   - 2.5. .Net Enumerations
   - 2.6. System.Object
   - 2.7. System Data Types
   - 2.8. System.String Data Type
   - 2.9. .Net Array types

3. Object-Oriented Programming with C#. [3]
   - 3.1. C# Class Type
   - 3.2. C#'s Encapsulation services
   - 3.3. C#'s Inheritance support
   - 3.4. Programming for Containment/Delegation
   - 3.5. C#'s Polymorphic support

4. Understanding Object Lifetime [3]
   - 4.1. Understanding Generations
   - 4.2. The System.GC type
   - 4.3. Building finalizable objects
   - 4.4. Building disposable objects

5. Exception Handling [4]
   - 5.1. Role of .NET exception handling
   - 5.2. Configuring the state of Exception
   - 5.3. System Level Exceptions
   - 5.4. Application level Exceptions

6. Interfaces and Collections [3]
   - 6.1. Implementing interface in C#
   - 6.2. Interfaces as parameters
   - 6.3. Arrays of Interface type
   - 6.4. Building Interface Hierarchies

7. Introducing .NET Assemblies [2]
   7.1. Role, Format of .NET Assembly
   7.2. Single-File, Multiple-File Assemblies
   7.3. Private Assemblies
   7.4. Shared Assemblies

8. Type Reflection, Late Binding, and Attribute-based programming [2]
   8.1. Necessity of Type Metadata
   8.2. Understanding Reflection
   8.3. Building custom metadata viewer
   8.4. Understanding Late Binding
   8.5. Understanding Attributed programming

9. Building multithreaded applications [2]
   9.1. Role of Thread Synchronization
   9.2. The Asynchronous nature of delegates
   9.3. The System.Threading.Thread Class

10. The System.IO Namespace [2]

11. System.Windows.Forms [6]

12. Database Access with ADO.NET [6]
   12.1. ADO.NET Data providers
   12.2. The System.Data Types
   12.3. Understanding Connected layer of ADO.NET
   12.4. Understanding the Disconnected layer of ADO.NET

13. ASP.NET Web Pages and Web Controls [5]

14. ASP.NET 2.0 Web Applications. [2]

Reference Books:

1. Pro C# 2005 and the .NET 2.0 Platform – Andrew Troelson

2. CLR via C# - Jeffery Richter

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MIM 406 Lab course (Semester IV)

Part A :
Web programming related assignments. These assignments will be evaluated internally for 40 marks.

Part B :
Project-evaluated for 60 Marks.