UNIVERSITY OF PUNE, PUNE.
SYLLABUS FOR M.TECH.
(INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS)
(Colleges Affiliated to Pune University)

(With effect from June 2013)

Introduction:
University of Pune has decided to change the syllabi of various faculties from June, 2013. Taking into consideration the rapid changes in science and technology and new approaches in different areas of Mathematics and related subjects, Board of Studies in Mathematics with consent of teachers of Mathematics from different colleges affiliated to University of Pune has prepared the syllabus of
M.TECH. (INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS**).**

The course will follow the credit system of the University of Pune.
The total credits required to complete the course will be 150.

To develop the syllabus the U.G.C. Model curriculum is followed.

Aims:
i) Give the students sufficient knowledge of fundamental principles, methods and a clear perception of the innumerous power of mathematical ideas and tools and knowledge of how to use them by modeling, solving and interpreting.
ii) Reflecting the broad nature of the subject and developing mathematical tools for continuing further study in various fields of science.
iii)Enhancing students' overall development and to equip them with mathematical modeling abilities, problem solving skill, creative talent and power of communication necessary for various kinds of employment .
iv) Enabling students to develop a positive attitude towards mathematics as an interesting and valuable subject of study.

Objectives:
(i) A student should be able to recall basic facts about mathematics and should be able to display knowledge of conventions such as notations, terminology and recognize basic geometrical figures and graphical displays, state important facts resulting from their studies.
(ii) A student should get a relational understanding of mathematical concepts and concerned structures, and should be able to follow the patterns involved with mathematical reasoning.
(iii) A student should get adequate exposure to global and local concerns so as to explore many aspects of Mathematical Sciences.
(iv) Students should be able to apply their skills and knowledge, that is, translate information presented verbally into mathematical form, select and use appropriate mathematical formulae or techniques in order to process the information and draw the relevant conclusion.
(v) A student should be made aware of history of mathematics and hence of its past, present and future role as part of our culture.
(vi) A student should be able to write necessary algorithms and programs in different languages as per the need of the industry.

Eligibility: B.Sc. with any Science stream with Mathematics subject up to second year or equivalent examination.

Structure of the course:

The credit system of the University of Pune will be followed.

Semester 1

MIM 101 Real Analysis	4 credits
MIM 102 Linear Algebra and Computational Geometry	4 credits
MIM 103 Discrete Mathematical Structures	4 credits
MIM 104 **C** Programming	4 credits
MIM 105 Elements of Information Technology	4 credits
MIM 106 Laboratory course 1	5 credits

All 6 above courses are compulsory. (total 25 credits)

Semester 2

MIM- 201 Complex Analysis	4 credits
MIM- 202 Algebra I	4 credits
MIM- 203 Numerical Analysis	4 credits
MIM- 204 C++	4 credits
MIM- 205 Data Structure Using C	4 credits
MIM- 206 Laboratory course 2	5 credits

All 6 above courses are compulsory. (total 25 credits)

Semester 3

MIM- 301 Topology	5 credits
MIM- 302 Design and analysis of algorithms	5 credits
MIM- 303 Object oriented software engineering	5 credits
MIM- 304 Operating systems	5 credits
MIM- 305 Data base fundamentals	5 credits
MIM- 306 Laboratory course 3	5 credits

All 6 above courses are compulsory. (total 30 credits)

Semester 4

MIM- 401 Ordinary differential equations	5 credits
MIM- 402 Coding theory	5 credits
MIM- 403 Computer Networks	5 credits
MIM- 404 Programming in PHP	5 credits
MIM- 405 JAVA programming	5 credits
MIM- 406 Laboratory course 4	5 credits

All 6 above courses are compulsory. (total 30 credits)

Semester 5

There will be 5 courses in Semester 5, each of 5 credits. These courses will be specified later.

MIM- 501	5 credits
MIM- 502	5 credits
MIM- 503	5 credits
MIM- 504	5 credits
MIM- 505	5 credits

Total 25 credits

Semester 6

MIM 601 Industrial training 15 credits.

For successful completion of the course, 150 credits will have to be obtained.

Detailed Syllabus

Semester 1

MIM -101 : Real Analysis

1. Metric Spaces and its Topology:
1.1 Metric Spaces Definition and Examples, k-cells, convex sets, open closed ball, properties
1.2 Definition : Neighborhood, limit point, isolated points, closed sets, interior points, open sets, perfect sets bounded sets, dense sets, examples and properties
1.3 Definition: Open cover, compact sets, examples and properties. Theorem of Weierstrass
1.4 Connected sets, definition of separated sets, connected sets and properties
2. Numerical Sequences and series
2.1 Convergent Sequences, Definition and Examples Properties
2.2 Subsequences: Definition and properties
2.3 Cauchy Sequences: Definition, Examples and properties, Definition of complete metric space, examples, Definition of Monotonic Sequences and its properties
2.4 Upper and lower limits, Definition, examples and properties
2.5 Convergence of some special sequences
2.6 Series: Definition, examples and properties, series of non-negative terms, Cauchy's condensation test and examples
2.7 The Number e
2.8 Root and ratio tests, examples
2.9 Power series, Definition, radius of Convergence, examples and properties
2.10 Summation by parts, absolute convergence
3. Continuity:
3.1 Limits of functions: Definition, examples and properties
3.2 Continuous functions, Definition, examples and properties,
3.3 Continuity and Compactness
3.3.1 Bounded Set: Definition
3.3.2 Continuous image of a compact set is compact and related properties
3.3.3 Definition of Uniform Continuity and related properties

3.4 Continuity and Connectedness: continuous image of connected set is connected and related properties
3.5 Discontinuities, Definition, examples
3.6 Monotonic functions, Definition examples and properties
4. Differentiation:
4.1 Derivative of a real function, Definition examples and properties
4.2 Mean Value Theorem
4.3 Continuity of derivatives,
4.4 Taylor's theorem
4.5 Differentiation of a vector valued function
5. Riemann Stieljes Integral:
5.1 Definition and existence of the integral, related properties
5.2 Properties of the integral
5.3 Integration and differentiation
5.4 Integration of vector valued functions
6. Sequences and series of function:
6.1 Discussion of main problem- with examples
6.2 Uniform convergence: Definition and properties
6.3 Uniform convergence: and continuity
6.4 Uniform convergence: and integration
6.5 Uniform convergence: and differentiation

Text Book:
Walter Rudin: Principles of Real Analysis, (3rd Edition, Tata McGraw Hill Publication)
Art. 2.15 to 2.42, 2.45 to 2.47, Art. 3.1 to 3.46, Art. 4.1 to 4.18 4.19 (Statement only), 4.22 to 4.28, 4.29 (Statement only), 5.1 to 5.12, 5.15 to 5.19, 6.1 to 6.15, 6.20, to 6.25, Art 7.1 to 7.17.

MIM 102:- Linear Algebra and Computational Geometry

1. **Vector Spaces**
1.1 Definitions & Examples
1.2 Simple properties of Vector Spaces
1.3 Subspaces: Definitions, Examples, Necessary and Sufficient conditions
1.4 Sum, Intersection of Subspaces
1.5 Quotient Space
1.6 Linear Span: Definitions & Properties
1.7 Linear Dependence & Independence: Definitions, examples & properties
1.8 Basis and dimension of a vector space, Dimension of subspaces, Dimension of a quotient space
1.9 Coordinates relative to a basis, coordinate vector, coordinate matrix
2. **Linear Transformations**
2.1 Definitions, Examples
2.2 Simple properties
2.3 Representation of a linear transformation as a matrix, change of basis
2.4 Rank-Nullity theorem
2.5 Algebra of linear transformation
3**. Eigen values & Eigenvectors of a Linear Transformation**
3.1 Definitions and Examples
3.2 Eigen values & Eigenvectors of a square matrix
3.3 Properties, Cayley Hamilton theorem
3.4 Diagonalization
4. **Inner Product Spaces**
4.1 Definitions & Examples, properties
4.2 Cauchy-Schwarz inequality

4.3 Orthonormal vectors, Orthogonal Complements
4.4 Orthonormal sets and bases
4.5 Gram Schmidt orthogonalization process
5. **Two-dimensional Transformations**
5.1 Representation of Points, Transformations and Matrices, Transformation of Points
5.2 Rotation, Reflection, Scaling, Combined Transformations, Transformation of the Unit Square, Solid Body Transformation,
5.3 Translations and Homogeneous Coordinates, Rotation About an Arbitrary Point, Reflection Through an Arbitrary Line,
5.4 Projection - A Geometric Interpretation of Homogeneous Coordinates, Overall Scaling, Points at Infinity, Transformation Conventions.
6. **Three Dimensional Transformations**
6.1 Three-Dimensional Scaling, Three-Dimensional Shearing, Three-Dimensional Rotation, Three-Dimensional Reflection, Three-Dimensional Translation.
6.2 Multiple Transformations,
6.3 Rotations about an Axis Parallel to a coordinate axis, Rotation about an Arbitrary Axis in Space,
6.4 Reflection through an Arbitrary Plane. Affine and Perspective Geometry,
6.5 Orthographic Projections, Axonometric Projections, Oblique Projections, Perspective Transformations.
6.6 Techniques for generating perspective views, Vanishing points,
7 **Plane Curves**
7.1. Curve representation, non-parametric curves, parametric curves,
7.2. Parametric representation of a circle, parametric representation of an Ellipse, parametric representation of a parabola, parametric representation of a Hyperbola.
7.3. A procedure for using conic sections. The general conic equations.
8 **Space Curves**
8.1 Bezier curves introduction, definition, properties (without proofs),
8.2 Curve fitting (up to n = 3), equation of the curve in matrix form (up to n = 3).
B-spline curves- introduction, definition, properties (without proof).

Reference Book:
Linear Algebra By David Lay: Mathematical Elements of Computer Graphics, Second Edition by D.F. Rogers, J. Alan Adams, McGraw-Hill Publishing Company.

MIM 103 Discrete Mathematical Structures

Formal Logic
1.1 Logic:
Introduction, Proposition, Simple proposition, Compound proposition, Truth value, Prepositional Calculus, operators, Conjunction, Disjunction, Conditional statement, Bi conditional statement, converse, contra positive and In-verse,
1.2 Predicates and Quantifiers: Introduction, Universal quantifier, existential quantifier, counter example, negating quantifiers, nested quantifier, order of quantifiers, truth value of quantifier.
1.3 Methods of proof: Introduction, theorem, proof, rules of inference, argument, valid argument, invalid argument, direct method of proof, indirect method of proof, rules of inference for quantified statements.
2. Counting:
The Basic of Counting, the Pigeonhole Principle, Permutations and Combinations, Binomial Coefficient. Inclusion -Exclusion and Applications of Inclusion-Exclusion.
Graph Theory
1. Graph: Definition, Vertex, Edge, Terminal vertices , self loop, incidence, adjacency finite, In finite graphs degree of a vertex. Isolated vertex, pendant vertex, Null graph, Hand shaking

Lemma, Regular graph, complete graph, Bipartite graph, Complete bipartite graph. (Theorem 1.1)
2. Isomorphism, Examples, Subgraph.
3. Operations on graphs: Union, Intersection, ring sum, sum of 2 graphs, fusion, Deletion of a vertex (edge), Decomposition of a graph.
4. Connected graph: walk path, circuit, component (Theorem 2.1, 2.2, 2.3)
5. Euler graph: Definition examples, Chinese postman problem, Fleury's algorithm. Arbitrarily Traceable graph. (Theorem 2.4, 2.6)
6. Trees: Definition, Pendant vertex in a tree, Distance and Centres in a tree. Rooted and binary trees, Spanning trees, rank nullity, Fundamental circuit, Fundamental cutset, vertex connectivity, edge connectivity, spanning tree, weighted graph, Kruskal's algorithm. (Theorem 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 6.7, 3.9, 3.11)
7. Planner graph: Introduction, Kuratowski's two graphs (K5, K3), Euler's theorem, problems (Theorem 5.1, 5.2, 5.6)
8. Matrix Representation: Incidence matrix, adjacency matrix, properties.
9. Directed graphs: Definition, Incident out of a vertex, incident into a vertex, indegree, outdegree, isolated vertex, pendant vertex, Types of digraphs, Simple Asymmetric, Symmetric, complete, Complete symmetric digraph, complete asymmetric digraph, Arborescence, Definition.
10. Graph theoretic algorithms: Dijkstra's algorithm, Warshall Floyd algorithm, Depth first search on a graph (Theorem 11.5, 11.6).
11. Networks: Flows and Cuts, Network, sink, source, capacity, Flow,
12. Maximal Flow, f-saturated, f- unsaturated. Ford and Fulkerson Algorithm
Section 8.1 and 8.2. Theorem 8.1, Theorem 8.2 (statement only) [Chapter-8 of Graph Theory by John Clark and Allan Holton]

Reference Book:-
1. K.H. Rosen : Discrete Mathematics and its Applications (TATA McGraw-HILL), 5th Edition
Chapter 1 Section 1.1, 1.2, 1.3, 1.4, 1.5, 1.6.
Chapter 4 Section 4.1, 4.2, 4.3, 4.4.
Chapter 6 Section 6.5, 6.6
3. N. Deo : Graph Theory with Applications to Comp. Sc. and Engineering. PHI Publication.
3. John Clark and Allan Holton : Graph Theory.

MIM-104: C Programming

1. Programming languages (1 Lecture)
1.1 Machine language
1.2 Assembly language
1.3 High level languages
1.4 Compilers and Interpreters
2. Introduction to C (1 Lecture)
2.1 History
2.2 Structure of a C program
2.3 Functions as building blocks
2.4 Application Areas
2.5 C Program development life cycle
3. C Tokens (8 Lectures)
3.1 Keywords
3.2 Identifiers
3.3 Variables
3.4 Constants character, integer, oat, string, escape sequences
3.5 Data types built-in and user defined

3.6 Operators and Expressions: Operator types (arithmetic, relational, logical, assignment, bitwise, conditional, other operators), precedence and associativity rules.
4. Input and Output (1 Lecture)
4.1 Character input and output
4.2 String input and output
4.3 Formatted input and output
5. Control Structures (5 Lectures)
5.1 Decision making structures: If, if-else, switch
5.2 Loop Control structures: While, do-while, for
5.3 Nested structures
5.4 break and continue
6. Functions in C (6 Lectures)
6.1 What is a function?
6.2 Advantages of Functions
6.3 Standard library functions
6.4User defined functions: Declaration, definition, function call, parameter passing (by value), return keyword,
6.5 Scope of variables, storage classes
6.6 Recursion
7. Arrays (4 Lectures)
7.1 Array declaration, initialization
7.2 Types one, two and multidimensional
7.3 Passing arrays to functions
8. Pointers (6 Lectures)
8.1 Pointer declaration, initialization
8.2 Dereferencing pointers
8.3 Pointer arithmetic
8.4 Pointer to pointer
8.5 Arrays and pointers
8.6 Functions and pointers passing pointers to functions, function returning pointers, pointer to function
8.7 Dynamic memory allocation
9. Strings (3 Lectures)
9.1 Declaration and initialization
9.2 Standard library functions
9.3 Strings and pointers
9.4 Array of strings.
10. Structures and Unions (4 Lectures)
10.1 Creating structures
10.2 Accessing structure members (dot Operator)
10.3 Array of structures
10.4 Passing structures to functions
10.5 Nested structures
10.6 Pointers and structures
10.7 Unions
10.8 Difference between structures and unions
11. C Preprocessor (2 Lectures)
11.1 Format of Preprocessor directive
11.2 File Inclusion directive
11.3 Macro substitution, nested macro, argument macro
11.4 Conditional compilation
12. Command Line Arguments (1 Lecture)
12.1. Accessing command line arguments
13. File Handling (3 Lectures)
13.1 Streams
13.2 Types of Files

13.3 Operations on files
13.4 Random access to files

References:
1. Kernighan and Ritchie : The C Programming language
2. Forouzan and Gilberg : Structured Programming approach using C, Thomson learning publications
3. Herbert Schildt : Complete C Reference

MIM-105 Elements of Information Technology

1: Introduction
1.1 Concept of Information Technology and its applications
1.2 What is a computer?
1.3 Basic structure of a computer
1.4 Characteristics of computers
2. Data Representation
2.1 Representation of data
2.2 Types of number systems
2.3 Need for binary systems
2.4 Representation of characters
3.4.1 The ASCII code
3.4.2 The EBCDIC code
3: Input/output units
3.1 Introduction to input/output units
3.2 VDU
3.3 Printer
3.3.1 Inkjet
3.3.2 Laser
3.4 A plotter
3.5 Input Methods
3.5.1Magnetic ink character reorganization
3.5.2 OMR
3.5.3 OCR
3.5.4 bar Coding
4: Computer memory organization
4.1 Memory Cell
4.2 Memory Organization
4.3 Physical devices used to construct memory
4.4 magnetic surface reading
4.5 magnetic Hard disk
4.6 CDROM/DVDROM
5: Processor
5.1 CPU
5.2 CU
5.3 ALU
5.3.1 Instruction Set
5.3.2 Different types of registers used in CPU (MAR, MBR, PC, A, I,I/O)
5.6 Processors speed
5.7 Types of processors
5.7.1 CISC
5.7.2 RISC
5.7.3 EPIC
5.7.4 Multi core processor
6: Main Memory

6.1 storage evaluation criteria
6.2 Why More bits?
6.3 Fix and variable word length memory
6.4 Types of memory chip
6.5 cache memory
7: Introduction of Computer architecture
7.1 interconnection of units
7.2 processor to memory communication
7.3 I/O to processor communication

Reference book:-
1. Fundamentals of computer by V Rajaraman, fourth edition, Prentice-Hall of India Pvt, Ltd
2. Fundamentals of computer by P K Sinha, sixth edition, BPB publication
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MIM 106 Laboratory course 1

Assignments List
1. Write Simple C Programs (Using operators only) Area of Triangle, Circle, Simple and Compound Interest, Celsius to Fahrenheit
2. Roots of Quadratic Equations.
3. Write a C program to accept a decimal number and convert it to Binary, Octal and Hexadecimal equivalent
4. Write a menu driven program to check if a given number is perfect / prime/ palindrome.
5. Computing sin x and cos x series.
6. Write a menu driven program to multiply, subtract and find transpose of the given matrices.
7. Display the single digit sum of the given number recursively.
8. String Manipulations using pointers
a. String length
b. Display substring from a given position and up to the given number of characters
c. Concatenate two strings
d. Uppercase to Lowercase
e. String compare Without using Standard Library functions
9. Write a C program to Insert and Delete an element in an array using Pointers.
10. Write a C program to accept information of n students having elds: Rollno, Name, Class, Grade(A/B/C). Display the information of those students who have A grade.
11. Write a program to add 2 matrices of size m x n using dynamic memory allocation.
12 Write a C program to create an **le** and count the number of words, lines and characters in the **le**.
13. Write a C program to encrypt /decrypt the contents of an **le** using command line arguments.

Semester 2

MIM 201 Complex Analysis

1 Complex Numbers
Sums and Products
Basic Algebraic Properties
Further Properties
Vectors and Moduli
Complex Conjugates
Exponential Form
Products and Powers in Exponential Form
Arguments of Products and Quotients

Zeros and Poles
Behavior of Functions Near Isolated Singular Points viii contents
7 Applications of Residues
Evaluation of Improper Integrals

Reference Books
Churchill & Brown: Complex variables and its Applications(Eight Edition, Tata McGrawHill)
S. Ponnuswamy: Foundations of Complex Analysis (Narosa Publication, Fourth Reprint)

MIM 202-ALGEBRA – I

1:- Groups
1.1 Definitions and Examples
1.2 Simple properties of Groups based on axioms
1.3 Order of an Element – Definition, properties and Examples
2:- Subgroups
2.1 Subgroups
2.2 Definition and Examples
2.3. NAS conditions for a Subgroups
2.4. Properties of Subgroups
3:- Cyclic groups
3.1 Cyclic groups
3.2 Definitions and Examples
3.3 Properties
4:- Permutation groups
4.1 Definition and Examples; (Permutation as composition of function)
4.2 Definition of __ and discussion of __ in detail
4.3 Cycles, Transpositions
4.4 Every Permutation is a product of disjoint cycles (without proof)
4.5 Even and odd permutations, order of a permutation
4.6 Alternating group __.
4.7
__
__
~_1,1_
5:- Homomorphism & Isomorphism
5.1 Definitions and Examples
5.2 Simple Properties
5.3 Isomorphism - Definition and Examples
5.4 Fundamental theorem of homomorphism & application
5.5 Cayley's theorem
6:- Cosets & Langrange theorem
6.1 Cosets - Definition, Examples & Properties
6.2 Lagrange's theorem and its corollaries
7:- Normal Subgroups
7.1 Definition and Examples
7.2 Properties of Normal Subgroups
7.3 Simple Groups, An is Simple for n = 5 (without proof)
7.4 Factor Group, Definition and Examples.
7.5 Properties of Factor groups
8:- Sylow's theorems
8.1. Class Equations
8.1.1. Conjugate of an element-Definition & Examples
8.1.2. Conjugacy relation is and equivalence relation, Conjugacy Class
8.1.3. Normaliser, Centraliser, Center of a group.

8.1.4. Class equation
8.1.5. ‘a’ belongs to Z(G) iff N(a) = G
8.1.6. Centre of a p-group is nontrivial.
8.1.7. Every group of order p-square is abelian.
8.2. Cauchy’s theorem (Statements only)
8.3. Sylow’s theorems (without proofs) - only problems.
9:- Rings
9.1. Definitions & Examples
9.2. Simple Properties of Rings.
9.3. Commutative ring, ring with unity, integral domain, field, skew field definitions, examples and interrelationships between them.
9.4. Subrings - Definition, Examples, Properties.
9.5. Characteristic of an integral domain.
10:- Ideals & Factor Rings
10.1. Definitions & Examples
10.2. Properties of ideals
10.3. Prime Ideals, Maximal Ideals.
10.4 Quotient rings
11:- Homomorphism & Isomorphism of rings
11.1. Definitions & Examples
11.2. Properties of ring homomorphisms
11.3. Fundamental theorem of ring homomorphisms & its applications.
12:- Polynomial Rings
12.1. Definitions & Examples
12.2. Properties
12.3. Polynomial ring F[x] over a field F.
12.4. F[x] is a Euclidean Ring.
12.5. Irreducible polynomials over a field

Text Books:
1) Contemporary Abstract Algebra by Joseph Gallian (Fourth Edition, Narosa Publication)
2) J.B. Fraleigh – Abstract Algebra, 5th edition
3) S. Gopala Krishnan, University Algebra

MIM 203 Numerical Analysis

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, Gauss-Seidel iteration
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, Runge-Kutta methods for systems of equations.
6. The Eigen value problem: Power method, Eigenvalues of symmetric matrices, Jacobi method,.

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 11.2
2. K. E. Atkinson : An introduction to Numerical Analysis (John Wiley Sons).
3. S. Sastry: Numerical Analysis

MIM 204- OBJECT ORIENTED PROGRAMMING WITH C++

1. 1. Introduction
1. Concept, Benefits and Application of OOP
2. Structure of C++ Programming
3. Tokens, expressions and control structures, keywords, Identifiers, data types & operators in C++.

2. Functions in C++
1. Function Prototyping
2. Call by value, Call by reference
3. Return by reference
4. Inline Functions
5. Default arguments
6. Function overloading
7. Friend and Virtual functions

3. Class and Objects
1. Introduction to classes and creating objects
2. Friend classes
3. Static class members
4. Nested classes
5. Local classes
6. Memory allocation for objects
7. Array to objects
8. Objects as function arguments
9. Constructors and destructors

4. Inheritance, Pointers, Virtual functions and Polymorphism
1. Single, Multilevel, Multiple, Hierarchical and Hybrid Inheritance
2. Virtual base classes
3. Abstract classes
4. Pointer to objects, pointer to derived class
5. Operator overloading

5. I/O System Basics
1. C++ streams, C++ stream classes
2. Formatted I/O, Unformatted I/O operations
3. Overloading <<and >>, creating own inserters
4. Extractor and manipulator functions

6. File I/O and Array Based I/O
1. Classes for file stream operations
2. Opening and closing of file, detecting EOF
3. Random access, I/O status
4. Array based class, Array based I/O stream, random access within the array
5. Dynamic arrays
6. Custom extractors and inserters

7. Templates and Exception Handling
1. Generic functions
2. Templates, class Templates, functions Templates
3. Member function templates, template arguments
4. Exception handling function templates, template arguments

5. Exception handling fundamentals, exception handling options
6. Catching all exceptions, restricting exceptions and rethrowing exceptions.

Reference books:

1. Object Oriented Programming with C++ - E. BALAGURUSWAMY
2. C++ the Complete Reference - HERBERT SCHILDT
3. A Treatise on Object Oriented Prog. Using C++ - B. CHANDRA
4. Serial communication - A C++ developers guide - NELSON

MIM 205: Data Structures using C

1. Introduction
1.1 Data, Data types, Abstract Data Type
1.2 Data Structures
1.3 Linear & Nonlinear data structures
1.4 Algorithm Analysis
2. Arrays
2.1 Arrays as ADT
2.2 1-D, 2-D, Multidimensional Arrays
2.3 Applications
2.4 Polynomial Representation in one variable (Using array of structure)
3. Stacks
3.1 ADT, Push and Pop operations
3.2 Stack implementation using array
3.3 Stack applications
3.3.1 Infix to postfix conversion of expression
3.3.2 Expression evaluation
3.3.3 Recursion
4. Queues
ADT, Insert and Delete operations
Queue implementation using array
Types –Priority Queue, Circular queue, Dequeue
4.4 Queue applications:
4.4.1 CPU Scheduling Algorithms
FCFS, Round Robin algorithm
5. Linked List Concept, Operations: Insert, Delete, Traversal
Static implementation using arrays
Dynamic implementation
Doubly Linked list
Circular list
Linked list applications:
Stacks and Queues as Linked Lists
Merging of two linked lists
6. Trees
6.1 Terminology and Concepts
6.2 Binary Tree Representation
6.2.1 Static implementation using arrays
6.2.2 Linked representation
6.2.3 Binary Search Tree
6.2.4 Operations on Binary search tree -Insert, Delete
6.2.5 Tree Traversals
6.3 Representing General Trees as binary tree
7. Searching and Sorting
Searching ,Concept and need ,Techniques

Linear search, Binary search, Indexed sequential search
Sorting ,Concept and Need ,Performance criteria
Techniques
Comparison Based-(Bubble, Quick, Insertion, Merge)
Linear order sorting-(Counting)
8. Graphs
8.1 Terminology and concepts
8.2 Graph Representation: Adjacency matrix, Adjacency list, Adjacency multilist
8.3 Traversals: Depth first and Breadth first
Reference Books:
1. Tanenbaum, Langsam, Augenstein : "Data structures using C", PHI 1994
2. D. Samanta : "Classic Data Structures", PHI 2002

MIM 206: Laboratory course 2
Assignment based on object oriented programming with C++ and Data structure using C.

Semester 3

MIM- 301 General Topology

Topological Spaces and Continuous Functions
Topological Spaces and Basis of Topology (Sections 12 and 13)
Ordered, Product , Metric and Subspace Topologies (Sections 14, 15,16 and 20)
Closed Sets, Limit Points and Hausdroff Spaces (Section 17)
Continuous Functions, Homeomorphisms, Rules of Constructing Continuous Functions and Pasting Lemma (Proof and Examples) (Section 18)
Introduction to Box Topology, Comparison of Product and Box Topologies (Section 19)
Connected Spaces
Introduction to Separation and Connected Spaces , Results and Examples (Section 23)
Connected Spaces, Intermediate value theorem, Path connected spaces and Examples (Section 24)
Components and Local Connectedness (Section 25)
Compact Spaces
Introduction to Compact Spaces , Tube Lemma , Finite Intersection Property and Examples (Section 26)
Compact Subspaces of Real Line, Extreme Value theorem(Section 27.1 to 27.4)
Limit Point Compactness (Section 28)
Local Compactness(Section 29)
One point Compactification
Countable and Separation Axioms
First and Second Countable Axiom, Lindelof Spaces with Example (Section 30)
Separation by Open sets (Regular and Normal Spaces) with Examples (Section 31 and 32)
Urysohn Lemma which is separation by Continuous Function (Theorem 33.1 Statement only)
The Tychonoff Theorem
Tychonoff theorem with Proof (Section 37)
Textbook:
Topology by James .R. Munkres (Second Edition)
References

1) Introduction to General Topology by K.D. Joshi

2) Topology and Modern Analysis by G.F. Simmons

3) Basic Topology by Armstrong Springer Verlag (Indian Edition)

4) General Topology by Kelley

5) Topology by James Dugundji

MIM 302 Design and Analysis of Algorithms

1. **Mathematical Foundations**
   - 1.1 Introduction to Algorithms
   - 1.2 Growth functions (Chapter 3 : sections 3.1 and 3.2)
   - 1.3 Recurrences : Substitution method, Recursion -Tree method, The Master method (Chapter 4 : 4.1, 4.2 , 4.3)
   - 1.4 Amortized Analysis (Chapter 17)Introduction

2. **Sorting**
   - 2.1 Heap Sort (6.1 to 6.4)
   - 2.2 Quick Sort (7.1, 7.2, 7.4)
   - 2.3 Merge Sort (2.3)
   - 2.4 Sorting in linear Time (8.1 to 8.4)

3. **Dynamic Programming**
   - 3.1 Matrix Chain Multiplication Problem(15.2, 15.3)
   - 3.2 Longest common subsequence (15.4)

4. **Greedy Algorithm**
   - 4.1 An activity selection problem (16.1)
   - 4.2 Elements of the greedy strategy (16.2)
   - 4.3 Huffman codes (16.3)
   - 4.4 Knapsack 0/1 problem

5. **Graphs**
   - 5.1 Traversals, topological sort (22.1 to 22.4)
   - 5.2 Minimum spanning trees m(23.1, 23.2)
   - 5.3 Single source shortest path : Dijkstra's and Bellman Ford Algorithm (24.1, 24.2, 24.3)
   - 5.4 All pair shortest path (25.1, 25.2, 25.3)

6. **NP-Completeness**
   - 6.1 Polynomial time (34.1)
   - 6.2 Polynomial time verification (34.2)
   - 6.3 NP-completeness and reducibility (34.3)
   - 6.4 NP-completeness proofs (34.4)
   - 6.5 NP-complete problems (34.5)

Text Book : Introduction to Algorithms (Prentice-Hall) :

By T. H. Coremen, C. E. Leiserson, R. L. Rivest, C. Stein

Reference Books

: (1) Fundamentals of Algorithms (Galgotia Publications)

By ; Horowitz, Sahani, Rajshekharan

(2) The introduction to Design and Analysis of Algorithms (Pearson) by Anany Levitin

MIM 303 Object Oriented Software Engineering (OOSE)

1. Introduction
1.1. Software, attributes of good software
Software Engineering
Software process,
Challenges facing software engineering.

2. Software processes
Software process models
Process iteration
Process activities

3. Socio-technical systems
System, System properties
System Engineering
Critical systems,
System dependability, availability, reliability, safety and security

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

5. System Models
Introduction to : Context models,
Behavioral models (Data Flow Diagrams),Data models

6. Unified Modeling Language
- Introduction to UML
- Basic Structural Modeling
  Classes , Relationship, Common mechanism, Diagrams, Class diagram
  - Packages, Object Diagram
  - Basic Behavioral Modeling
    Interactions
    Use cases, Use Case Diagram
    Interaction Diagram
    Activity Diagram

State chart Diagram

- Architectural Modeling
  Component , Components Diagram
  Deployment Diagram, Collaboration diagram

- Object Oriented Design
  An object oriented design process

6. Distributed Systems Architectures
Client server architectures
Distributed object architectures

7. Rapid software Development
Agile methods
Extreme programming
Rapid application development

8. Verification and validation
Verification and validation
Software Inspections
Automated static analysis
Verification and formal methods

9. Software testing
a. Object oriented Testing Strategies
b. Test case design for OO Software
c. Inter Class Test case design

Reference Books:
1. Software Engineering (7th Edition) by Ian Sommerville Pearson education
2. Software Engineering A Practitioners Approach 6th, 7th Edition Roger S. Pressman [McGraw Hill International Edition]
3. The Unified Modeling Language User Guide By Grady Booch, James Raumbaugh and Ivar Jacobson.

MIM -304 Operating Systems

1. **Introduction to Operating System**
   - 1.1 What operating system can Do
     - 1.1.1 user view
     - 1.1.2 system view
     - 1.1.3 defining operating systems
   - 1.2 Computer- System organization
     - 1.2.1 Computer System operation
     - 1.2.2 Storage structure
     - 1.2.3 I/O structure
   - 1.3 Computer-system architecture
     - 1.3.1 Single-processor systems
     - 1.3.2 Multiprocessor systems
     - 1.3.3 Clustered systems
   - 1.4 Operating system structure
   - 1.5 Operating system operations
     - 1.5.1 Dual Mode operation
     - 1.5.2 Timer

1.6 Process management
1.7 Memory management
1.8 Storage management
    1.8.1 File System management
    1.8.2 Mass-storage management
    1.8.3 Caching
    1.8.4 I/O subsystems
1.9 Protection and security
1.10 Distributed system
1.11 Special purpose system
    1.11.1 Real-time embedded systems
    1.11.2 Multimedia systems
    1.11.3 Handheld systems
1.12 Computing environment
    1.12.1 Traditional computing
    1.12.2 Client-server computing
    1.12.3 Peer-to-peer computing
    1.12.4 Web-based computing
1.13 Open-source operating system
    1.13.1 History
    1.13.2 Linux

2. System structure

2.1 Operating system services
2.2 User operating system Interface
    2.2.1 Command Interpreter
    2.2.2 Graphical user interface
2.3 System calls
2.4 Types of system calls
    2.4.1 Process control
    2.4.2 File management
    2.4.3 Device management
    2.4.4 Information maintenance
    2.4.5 Communication
    2.4.6 protection
2.5 System programs
2.6 System Boot

Process Management

2.7 Process Concept
    2.7.1 The process
    2.7.2 Process State
    2.7.3 Process control block
    2.7.4 threads
2.8 Process Scheduling
    2.8.1 Scheduling queues
    2.8.2 Schedulers
    2.8.3 Context switch
2.9 Operations on Processes
    2.9.1 Process creation
    2.9.2 Process termination

3. Process Scheduling

3.1 Basic Concepts
    3.1.1 CPU- I/O Burst Cycle
    3.1.2 CPU Scheduler
    3.1.3 Preemptive and Non-preemptive scheduling
    3.1.4 Dispatcher

- 3.2 Scheduling criteria (terminologies used in scheduling): CPU Utilization, Throughput, Turnaround time, Waiting time, Response time
- 3.3 Scheduling Algorithms – FCFS, SJF (Preemptive & non-preemptive), Priority Scheduling (Preemptive & non-preemptive), round robin scheduling with examples
- 3.4 Multilevel Queues, Multilevel Feedback queues

4. Process Synchronization

- 4.1 Background
- 4.2 The critical section problem
- 4.3 Semaphores
  - 4.3.1 Usage
  - 4.3.2 Implementation
  - 4.3.3 Deadlock and starvation
  - 4.3.4 Priority Inversion
- 4.4 Classic Problems of Synchronization
  - 4.4.1 the bounded buffer problem
  - 4.4.2 the readers –writers problem
  - 4.4.3 the dinning philosophers problem

5. Deadlocks

- 5.1 System Model
- 5.2 Deadlock characterization
  - 5.2.1 Necessary conditions
  - 5.2.2 Resource allocation graph
- 5.3 Methods for handling deadlocks
- 5.4 Deadlock prevention
  - 5.4.1 Mutual exclusion
  - 5.4.2 Hold and wait
  - 5.4.3 No preemption
  - 5.4.4 Circular wait
- 5.5 Deadlock avoidance
  - 5.5.1 Safe state
  - 5.5.2 Resource allocation graph algorithm
  - 5.5.3 Banker's algorithm
    - 5.5.3.1 Safety algorithm
    - 5.5.3.2 Resource request algorithm
    - 5.5.3.3 Examples
- 5.6 Deadlock detection
  - 5.6.1 Single instance of each resource type
  - 5.6.2 Several instances of a resource type
  - 5.6.3 Detection algorithm usage
- 5.7 Recovery from deadlock
  - 5.7.1 Process Termination
  - 5.7.2 Resource preemption

6. Memory management

- 6.1 Background
  - 6.1.1 Basic Hardware
  - 6.1.2 Address Binding
  - 6.1.3 Logical versus physical address space
  - 6.1.4 Dynamic loading
  - 6.1.5 Dynamic linking and shared libraries
- 6.2 Swapping
- 6.3 Contiguous memory allocation
  - 6.3.1 memory mapping and protection
  - 6.3.2 memory allocation
  - 6.3.3 fragmentation
- 6.4 paging
  - 6.4.1 Basic method

- 6.4.2 Hardware support
- 6.4.3 Protection
- 6.4.4 Shared pages

6.5 Segmentation
- 6.5.1 Basic Method
- 6.5.2 hardware

6.6 virtual memory management –background

6.7 demand paging
- 6.7.1 Basic Concepts
- 6.7.2 Performance of demand paging
- 6.7.3 Page replacement – with examples
  - 6.7.3.1 Basic page replacement
  - 6.7.3.2 FIFO
  - 6.7.3.3 Optimal
  - 6.7.3.4 LRU – using counter and stack
  - 6.7.3.5 Second chance
  - 6.7.3.6 LFU
  - 6.7.3.7 MFU

7. File systems

7.1 File concept
- 7.1.1 File attributes
- 7.1.2 File operations
- 7.1.3 File types
- 7.1.4 File structure
- 7.1.5 Internal file structure

7.2 Access Methods
- 7.2.1 Sequential Access
- 7.2.2 Direct Access
- 7.2.3 Other Access Methods

7.3 Directory and Disk Structure
- 7.3.1 Storage Structure
- 7.3.2 Directory Overview
- 7.3.3 Single-level directory
- 7.3.4 Two-level directory
- 7.3.5 Tree structured directories
- 7.3.6 Acyclic graph directories
- 7.3.7 General graph directory

7.4 File system mounting

File system sharing
- 7.4.1 Multiple Users
- 7.4.2 Remote file systems
  - 7.4.2.1 The client-server model
  - 7.4.2.2 Distributed Inforamtion systems
  - 7.4.2.3 Failure modes

7.5 Protection
- 7.5.1 Types of access
- 7.5.2 Access control

7.6 Allocation methods
- 7.6.1 Contiguous
- 7.6.2 Linked
- 7.6.3 Indexed

7.7 Free space management
- 7.7.1 Bit Vector
- 7.7.2 Linked List
- 7.7.3 Grouping
- 7.7.4 Counting

8. Disk Scheduling and I/O systems

8.1 Concept

8.2 Disk Scheduling algorithms – with examples

8.2.1 First Come First Served FCFS

8.2.2 Shortest seek time first (SSTF)

8.2.3 Scan

8.2.4 C-scan

8.2.5 Look

8.3 Kernel I/O subsystems

8.3.1 I/O Scheduling

8.3.2 Buffering

8.3.3 Caching

8.3.4 Spooling and device reservation

8.3.5 Error handling

8.3.6 I/O protection

8.3.7 Kernel data structure

Reference Books :

1. Operating System Concepts – Silberschatz, Galvin, Gagne
2. Modern Operating system by Tanenbaum , PHI Publication
3. Operating Systems : Principles and Design – Pabitra Pal Choudhary (PHI Learning Private Limited)

MIM 305: Database Fundamentals

1 Introduction to Database Systems

1.1 Introduction

1.2 Basic Concepts and Definition

1.2.1 Data

1.2.2 Information

1.2.3 Data versus Information

1.2.4 Data warehouse

1.2.5 Metadata

1.2.6 Data Item or Field

1.2.7 Records

1.2.8 Data Dictionary

1.2.9 Database

1.2.10 Database System

1.3 Database Users and Database Administrator

1.4 Functions and Responsibilities of DBA

1.5 File-oriented System versus Database System

1.6 View of Data

1.7 Database Languages

1.8 Schemas, Sub-schemas and Instances

1.9 3-Level Architecture

1.9.1 Internal Level

1.9.2 Conceptual Level

1.9.3 External Level

1.10 Data Independence

1.10.1 Physical Data Independence

1.10.2 Logical Data Independence

1.11 Structure of a DBMS

1.12 Functions of DBMS

1.13 Data Models

References: 1, 2

2 **Physical Data Organization**

- 2.1 Introduction
- 2.2 Physical Storage Media
- 2.3 RAID Technology
- 2.4 Basic concepts of File
  - 2.4.1 File Types
  - 2.4.2 Buffer Management
  - 2.4.3 File organization
- 2.5 Indexing

References: 1, 2

3 Relational models

- 3.1 Introduction
- 3.2 Structure of Relational Database
- 3.3 Relational Algebra
  - 3.3.1 Selection Operation
  - 3.3.2 Projection Operation
  - 3.3.3 Union Operation
  - 3.3.4 Cartesian Product Operation
  - 3.3.5 Difference Operation
  - 3.3.6 Intersection Operation
  - 3.3.7 Division Operation
  - 3.3.8 Rename Operation
  - 3.3.9 Join operation
- 3.4 Relational Calculus
  - 3.4.1 Tuple Relational Calculus
- 3.5 Relational Algebra Vs Calculus

References: 1, 2

4 **Databases and Relational Database Design**

- 4.1 Introduction
- 4.2 Basic E-R Concepts
- 4.3 keys
- 4.4 Constraints
- 4.5 Entity Set
  - 4.5.1 Strong Entity Set
  - 4.5.2 Week Entity Set
- 4.6 E-R Diagram Symbol
- 4.7 E-R Diagram
- 4.8 Extended E-R Features
- 4.9 Conversion of E-R Model into Relations
- 4.10 Functional Dependency
- 4.11 Full Functional Dependency
- 4.12 Armstrong’s Axioms
- 4.13 Redundant Functional Dependencies
- 4.14 Closures of a set of Functional Dependencies
- 4.15 Decomposition
- 4.16 Normalization
- 4.17 Normal forms
  - 4.17.1 First Normal Form
  - 4.17.2 Second Normal Form
  - 4.17.3 Third Normal Form

4.17.4 Boyce-Codd Normal Form (BCNF)
4.17.5 Fourth Normal Form
4.17.6 Fifth Normal Form
References: 1, 2

5 SQL

5.1 Introduction
5.2 Basic Structure
5.3 Aggregate Functions
5.4 Null Values
5.5 Nested Subqueries
5.6 Views
5.7 Complex Queries
5.8 Modification of Database
5.10 Integrity and Security Constraints
5.11 Security and Authorization
5.12 Triggers and Cursors
References: 2, 4

6 Transaction Management

6.1 Transaction Concepts
6.2 Transaction Properties
6.3 Transaction States
6.4 Concurrent Execution
6.5 Serializability
6.6 Recoverability
References: 1, 2

7 Concurrency Control & Database Recovery System

7.1 Introduction
7.2 Lock based Protocols
7.2.1 Locks
7.2.2 Granting of locks
7.2.3 Two Phase Locking Protocol
7.2.4 Time Stamp-Based protocol
7.2.5 Thomas Write Rule
7.2.7 Multiple Granularity
7.2.8 Deadlock Handling
7.3 Database Recovery Concepts
7.4 Types of Database Recovery
7.5 Recovery Technique
7.5.1 Deferred Update
7.5.2 Immediate Update
7.6 Buffer Management
References: 1, 2

Recommended Books:

• Database Systems: Concepts, Design and Applications, Singh, ISBN: 9788131760925, Pearson
• Database Management Systems, Raghu Ramakrishnan, Johannes Gehrke, ISBN: 9780072465631, TMH
• Database Systems Concepts, Abraham Silberschatz, Henry Korth, S. Sudarshan, ISBN: 9780071244763, TMH
• Database Systems, Connolly, ISBN: 9788131720257, Pearson
• A Guided Tour of Relational Databases and Beyond, Levene, ISBN:9788181280510,

Springer
• Fundamentals of Database Management Systems, Gillenson, ISBN:9788126517930, Wiley India
• Database Design and Relational Theory C.J. Date, ISBN:9789350237298,O'Reilly
• An Introduction to Database Systems, Date/Kanna, ISBN, 9788177585568 , Pearson
• Fundamentals of Database Systems, Elmasri, ISBN:9788131716250 , Pearson
• Database-Principles, Programming and Performance, O'Neil, ISBN:9789380501284, Elsevier
• Database System Implementation, Garcia-Molina, ISBN:9788131704134, Pearson

MIM 306 Laboratory course 3

Assignments based on MIM 304 and MIM 305

Semester 4

MIM 401 Ordinary Differential Equations

Review : General remarks on solutions of differential equations, Families of curves, Orthogonal trajectories.
1. Second order linear equations : The general solution of the homogeneous equations, Use of a known solution to find another solution, Homogeneous equations with constant coefficients. The method of undetermined coefficients. The method of variation of parameters.
2. Qualitative Properties of solutions of ordinary differential equations of order two : Sturm separation theorem. Normal form, Standard form, Sturm's comparison theorem.
3. Power Series solutions : Review of power series, Series solutions of first order equations, Second order linear equations, Ordinary points, Regular singular points, Indicial equations, Gauss's Hypergeometric equation, The point at infinity.
4. Systems of first order equations : General remarks on systems, Linear systems, Homogenous linear systems with constant coefficient. Non-linear systems, Volterra's Prey-Predator equations.
5. Non-linear equations : Autonomous systems, Critical points, Stability, Liapunov's direct method, Nonlinear mechanics, Conservative systems.
6. The existence and uniqueness of solutions. The method of successive approximations, Picard's theorem, Systems, The second order linear equations.
Text Book :
G.F. Simmons : Differential equations with applications and Historical Notes, Second Edition (Mc-Graw Hill). Sections : 15 to 19, 24 to 31, 54 to 63, 68 to 70.
Reference Books :
1. G. Birkhoff and G.C. Rota : Ordinary differential equations. (John Wiley and Sons)
2. E. A. Coddington : Ordinary differential equations. Prentice Hall of India.
3. S. G. Deo, V. Lakshmikantham, V. Raghvendra. Text book of Ordinary Differential Equations. Second edition.Tata Mc-Graw Hill.

MIM 402 : Coding Theory

1. Error detection: correction and decoding: Communication channels, Maximum likelihood decoding, Hamming distance, Nearest neighbour/ minimum distance decoding, Distance of a code.(section 2.1,2.2,2.3,2.4,2.5 from Coding Theory A First Course by Ling and Xing)

2. Finite fields (section 3.1,3.2,3.3,3.4 ,theorems without proof from Ling and Xing)

3. Linear codes: Vector spaces over finite fields, Linear codes, Hamming weight, Bases of linear codes, Generator matrix and parity check matrix, Equivalence of linear codes, Encoding with a linear code,Decoding of linear codes, Cosets, Nearest neighbour decoding for linear codes, Syndrom decoding. (section 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8 from Ling and Xing)

4. The main coding theory problem,Idea of bounds Gilbert-Varshamov bound, Hamming bound (Definition only) ,Binary Hamming codes, q-ary Hamming codes(section 5.1,5.2,5.3.1,5.3.2 From Ling and Xing)

5. Cyclic codes: Definitions, Generator polynomials, Generator and parity check matrices, Decoding of cyclic codes, Burst-error-correcting codes.(section 7.1,7.2,7.3,7.4,7.5 by Ling and Xing)

6. Some special cyclic codes: BCH codes, Definitions, Parameters of BCH codes, Decoding of BCH codes, Reed Solomon codes,quadratic residue codes (definition and examples only)(sections 8.1,8.2,8.3 by Ling and Xing)

Reference Books:

1. San Ling and Chaoing xing , Coding Theory- A First Course .
2. Lid and Pilz, Applied Abstract Algebra - 2nd Edition
3. J.H. van Lint Introduction to Coding Theory , Third Edition

MIM 403 Computer Networks

Chapter 1. Network Models

- 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.
- Book 2 Chapter 2 unit 2.2 – 2.4

Chapter 2. Physical Layer

- 2.1. Tasks Performed – Book 2 Chapter 2, Pg 33-34
- 2.2. Data and Signals
  - 2.2.1. Analog and Digital
    - 2.2.1.1 Analog and digital Data
    - 2.2.1.2 Analog and Digital Signals
    - 2.2.1.3 Periodic and Nonperiodic Signals
- 2.3 Periodic Analog Signals
  - 2.3.1 Sine wave
  - 2.3.2 Phase
  - 2.3.3 Wavelength
  - 2.3.4 Time and Frequency Domains
  - 2.3.5 Composite signals
  - 2.3.6 Bandwidth
- 2.4 Digital Signals
  - 2.4.1 Bit rate
  - 2.4.2 Bit length
  - 2.4.3 Digital Signal as a Composite Analog Signal
  - 2.4.4 Transmission of Digital Signals
- 2.5 Transmission Impairment
  - 2.5.1 Attenuation
  - 2.5.2 Distortion
  - 2.5.3 Noise

2.6 Data Rate Limits
2.6.1 Noiseless Channel: Nyquist Bit Rate
2.6.2 Noisy Channel: Shannon Capacity
– Book 2, Chapter 3, Units 3.1 – 3.5
2.7. Digital Transmission
2.7.1. Digital – To - Digital Conversion
2.7.1.1 Line coding - Some characteristics of Line coding
2.7.1.2. Line coding scheme – Unipolar, Polar with examples of each method
– Book 2, chapter 4, Unit 4.1, pages 101-110.
2.8. Analog –To – Digital Conversions
2.8.1. Pulse Code Modulation (PCM)
2.8.2. Delta Modulation
– Book 2, chapter 4, Unit 4.2, Pages 121-131 without examples
2.9. Transmission Modes
2.9.1. Parallel Transmission
2.9.2. Serial Transmission
– Book 2, chapter 4, Unit 4.3 Pages 131 - 135
2.10. Transmission Media
2.10.1. Guided Media
2.10.1.1 Twisted Pair – UTP vs, STP, Categories, Connectors
2.10.1.2 Coaxial Cable – standards, connectors,
2.10.1.3 Fiber Optic Cable – propagation mode, connectors
2.10.2. Unguided Media (Wireless)
2.10.2.1 Radio Waves – omnidirectional antenna
2.10.2.2 Microwaves – Unidirectional Antenna
2.10.2.3 Infrared
– Book 2, chapter 7, Units 7.1, 7.2 pages 192 -208
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

Chapter 3. Data Link Layer

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 3.1.1, 3.1.2, 3.1.3 and 3.1.4
3.2. Error Detection and Correction
3.2.1. Types of Errors – Single bit and burst errors
3.2.2 Redundancy
3.2.3 Detection versus correction
3.2.4 Forward error correction versus Retransmission
3.2.5 Coding
3.2.6 Modular Arithmetic
– Book 2, chapter 10, Unit 10.1
3.3 Error Detecting Codes
3.4 Error Correcting Codes
- Book 1 chapter 3 Unit 3.2.1 and 3.2.2
3.5. Elementary Data Link Protocols
3.5.1. Unrestricted Simplex protocol
3.5.2. A simplex stop- and – wait protocol
3.5.3. A simplex protocol for a noisy channel
– Book 1, chapter 3, Unit 3.3

3.6. Sliding Window protocols
- 3.6.1. One-bit sliding window protocol
- 3.6.2. A protocol using Go Back N
- 3.6.3. A protocol using Selective Repeat

– Book 1, chapter 3, Unit 3.4

Chapter 4. The Medium Access Sublayer

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 – ALOHA, CSMA, CSMA/CD, CSMA/CA
- 4.2.2. Controlled Access – Reservation, Polling, Token Passing
- 4.2.3. Channelization – FDMA, TDMA, CDMA concepts

– Book 2, chapter 12, Units 12.1 – 12.3

4.3. Wired LANs: Ethernet
- 4.3.1. IEEE Standards
  - 4.3.1.1 Data Link Layer
  - 4.3.1.2 Physical Layer
- 4.3.2. Standard Ethernet
  - 4.3.2.1 MAC Sublayer – Frame format, frame length, Addressing, Access method:CSMA/CD
  - 4.3.2.2 Physical Layer
- 4.3.3 Changes in the Standard
  - 4.3.3.1 Bridged Ethernet
  - 4.3.3.2 Switched Ethernet
  - 4.3.3.3 Full Duplex Ethernet
- 4.3.4 Fast Ethernet
  - 4.3.4.1 MAC Sublayer
  - 4.3.4.2 Physical Layer
- 4.3.5.Gigabit Ethernet
  - 4.3.5.1 MAC Sublayer
  - 4.3.5.2 Physical Layer

– Book 2, chapter 13, Unit 13.1 – 13.5

4.4. Wireless LANs
- 4.4.1. IEEE 802.11 Architecture: BSS and ESS, Station types
- 4.4.2. Bluetooth – Architecture : Piconets and scatternet

- Book 2, chapter 14, Unit 14.1, Page 421-422 and Unit 14.2, Page 434-436

4.5 Virtual LANs

- Book 2 Chapter 15 Unit 15.3, Page 458 - 460

Chapter 5. Network Layer

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. Routing Algorithms
- 5.2.1. Optimality Principle
- 5.2.2. Shortest Path Routing
- 5.2.3. Flooding
- 5.2.4. Distance Vector Routing
- 5.2.5. Link State Routing

- Book 1, Chapter 5, Unit 5.2.1 – 5.2.5 Pages 351-358 and 360-366

5.3. IPv4 Addresses
- 5.3.1. Address space
- 5.3.2. Notations
- 5.3.3. Classful Addressing
- 5.3.4. Classless Addressing

– Book 2, chapter 19, Units 19.1 pages 549 - 560

5.4 Network layer Protocol
- 5.4.1 IPv4

- Book 2 Chapter 20 Unit 20.2 Pages – 582-596

5.5. Address Mapping
- 5.5.1. Mapping Logical to Physical Address: ARP
- 5.5.2 Mapping Physical to Logical Address: RARP, BOOTP and DHCP

– Book 2, chapter 21, Unit 21.1

5.6 Congestion Control Algorithms
- 5.6.1. Concept
- 5.6.2. General Principles of Congestion Control
- 5.6.3. Congestion Control Prevention Policies
- – Book 1, chapter 5, Unit 5.3,5.3.1,5.3.2

5.7 Internetworking
- 5.7.1. How networks Differ

- Book 1, chapter 5, Unit 5.5.1

Chapter 6. Transport Layer

6.1. The Transport Service
- 6.1.1. Services provided to the Upper layers
- 6.1.2. Transport Service primitives
- 6.1.3 Berkeley Sockets
- – Book 1, chapter 6, unit 6.1.1, 6.1.2, 6.1.3

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 Service Model
- 6.4.3. The TCP Protocol
- 6.4.4. The TCP Segment Header
- 6.4.5 The TCP connection establishment
- 6.4.6 The TCP connection release
- – Book 1, chapter 6, Units 6.5.1, 6.5.3, 6.5.4, 6.5.5, 6.5.6

Chapter 7. Network security

7.1 Firewalls

7.2 Virtual Private Networks

7.3 Social Issues
- 7.3.1 Privacy
- 7.3.2 Anonymous Remailers

7.3.3 Freedom of speech
7.3.4 Steganography
7.3.5 Copyright

- Book 1 Chapter 8 pages 776-780 and 819-828

Reference Books

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

MIM-404 Programming in PHP

1. **Introduction to web techniques**

HTTP basics, Introduction to Web server and Web browser
Introduction to PHP
What does PHP do?
Lexical structure
Language basics

2. **Function and String**

Defining and calling a function
Default parameters
Variable parameters, Missing parameters
Variable function, Anonymous function
Types of strings in PHP
Printing functions
Encoding and escaping
Comparing strings
Manipulating and searching strings
Regular expressions

3. **Arrays**

Indexed Vs Associative arrays
Identifying elements of an array
Storing data in arrays
Multidimensional arrays
Extracting multiple values
Converting between arrays and variables
Traversing arrays
Sorting
Action on entire arrays
Using arrays

4. **Introduction to Object Oriented Programming**

Classes
Objects
Introspection
Serialization
Inheritance
Interfaces
Encapsulation

5. **Files and directories**

Working with files and directories
Opening and Closing, Getting information about file, Read/write to file,
Splitting name and path from file, Rename and delete files
Reading and writing characters in file
Reading entire file
Random access to file data
Getting information on file
Ownership and permissions

6. Web Techniques
Variables
Server information
Processing forms
Setting response headers
Maintaining state
SSL

7. Databases
Using PHP to access a database
Relational databases and SQL

8. XML
What is XML?
XML document Structure
PHP and XML
XML parser
The document object model
The simple XML extension
Changing a value with simple XML

References
1. Programming PHP Rasmus Lerdorf and Kevin Tatroe O'Reilly publication
2. Beginning PHP 5 Wrox publication
3. PHP web sevices Wrox publication
4. PHP cookbook O' Reilly publication
5. PHP for beginners Ivan Bayross

MIM 405 Java Programming

1. Introduction to Object Oriented Concepts
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
2.1. The Java platform, Java buzzwords, API, JVM
2.2. Java compiler, bytecodes
2.3. java editions

3. Main features of Java language
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
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
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
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
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
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
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
10.1. 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

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
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 406 Laboratory course 4

Assignments based on MIM 404 and MIM 405

Equivalence of subjects
For M.Tech 1st year (SEM I & II)

Old course	Equivalent new course
Semester –I	
1. MIM-101 Real Analysis	MIM-101 Real Analysis
2. MIM-102 Algebra I	MIM-202 Algebra
3. MIM-103 Discrete Mathematical Structure	
4. MIM-104 C Programming	MIM-104 C Programming
5. MIM-105 Elements of Information Technology	MIM-105 Elements of Information Technology
6. MIM-106 Lab work	MIM-106 Lab work
Semester -II	
7. MIM-201 Real and complex Analysis	MIM-201 Complex Analysis
8. MIM-202 Algebra II	MIM-102 Linear Algebra and computaional geometry
9. MIM-203 Discrete Mathematical Structure – II	MIM-103 Discrete Mathematical Structure
.	
10. MIM-204 Database Fundamentals	MIM-305 Database Fundamentals

11. MIM-205 Data Structure Using C	MIM-205 Data Structure Using C
12. MIM-206 Lab work	MIM-206 Lab work

Old course	**Equivalent new course**

Semester III

13. MIM-301 Numerical Analysis	MIM- 203 Numerical analysis
14. MIM-302 Software engineering	MIM-303 O. O. Software enginineering
15. MIM-303 Object oriented programming in JAVA	MIM-405 JAVA programming
16. MIM-304 Operating systems	MIM-304 Operating systems
17. MIM-305 Theoretical computer science	MIM-
18. MIM-306 Lab work	MIM-306 Lab work

Semester IV

19. MIM-401 Topology	MIM-301 Topology
20. MIM-402 Networking	MIM- 403 Computer networks
21. MIM-404 Design and analysis of algorithms	MIM-302 Design and analysis of algorithms
22. MIM-406 Lab work	MIM-406 Lab work

The equivalence of the following courses will be decided later.

23. MIM-403 Web technologies	MIM-
24. MIM-405 Elective 1	MIM-

Semester V

25. MIM-501 Operatiions research	MIM-
26. MIM-502 Statistical and numerical methods	MIM-
27. MIM-503 Modelling and simulation	MIM-
28. MIM-504 Advaned opearating systemsithms	MIM-
29. MIM-505 Elective 1	MIM-
30. MIM-406 Lab work	MIM-206 Lab work