SYLLABUS FOR M.SC (TECH)- I

(For the Colleges Affiliated under Pune University)

(INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS)
FOR THE YEAR I
(SEMESTER I, II)

SEMESTER – I
MIM- 101 – Real Analysis
MIM- 102 – Algebra – I
MIM- 103 – Discrete Mathematical Structure – I
MIM- 104 – C Programming
MIM- 105 – Elements of Information Technology
MIM- 106_ Lab work (Assignment List)

SEMESTER – II
MIM- 201 – Real and complex Analysis
MIM- 202 – Algebra – II
MIM- 203 – Discrete Mathematical Structure - II
MIM- 204 – Database Fundamentals
MIM- 205 – Data Structure Using C
MIM- 206 – Lab work (Assignment List)

MIM -101 : Real Analysis

Topic 1 : Metric Spaces and its Topology:

1.1 Metric Spaces Definition and Examples, k-cells, convex sets, open closed ball, properties

1.2 Definitions: Neighborhood, limit point, isolated points, closed sets, interior points, open sets, perfect sets bounded sets, dense sets, examples and properties

1.3 Definitions: Open cover, compact sets, examples and properties. Theorem of Weierstrass

1.4 Connected sets, definition of separated sets, connected sets and properties

(Text Book: Walter Rudin : Principles of Real Analysis, 3rd Edition Art 2.15 to 2.42, 2.45 to 2.47)

Topic 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

(Text Book: Walter Rudin : Principles of Real Analysis: 3rd Edition Art. 3.1to 3.46)

Topic 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

[Text Book: Walter Rudin: Principles of Real Analysis 3rd Edition Art. 4.1 to 4.18 4.19 (Statement only) , 4.22 to 4.28, 4.29 (Statement only)]

Topic 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

(Text Book: Walter Rudin Principles of Real Analysis: 3rd Edition Art 5.1 to 5.12, 5.15 to 5.19)

Topic 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

(Text Book: Walter Rudin: Principles of Real Analysis : 3rd Edition Art 6.1 to 6.15. 6.20 to 6.25)

Topic 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 Art 7.1 to 7.17)

MIM 102- ALGEBRA – I

Chapter 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

1.4 Subgroups

- 1.4.1. Definition and Examples
- 1.4.2. NAS conditions for a Subgroups
- 1.4.3. Properties of Subgroups

1.5 Cyclic groups

- 1.5.1. Definitions and Examples
- 1.5.2. Properties

1.6 Counting Principle (Without Proof)

1.7 Cosets- Definition, Examples & Properties

1.8 Lagrange's theorem and its corollaries

Chapter- 2:- Normal Subgroups

2.1. Definition and Examples

2.2. NAS conditions for Subgroups

2.3. Properties of Normal Subgroups

2.4. Simple Groups, A_n is Simple for $n \geq 5$ (without proof)

2.5 Quotient Group, Definition and Examples.

2.6. Properties of Quotient groups

Chapter- 3:- Homomorphism

3.1 Definitions and Examples

3.2 Simple Properties

3.3 Isomorphism- Definition and Examples

3.4 Fundamental theorem of homomorphism & application

3.5 Cayley's theorem

Chapter- 4:- Normal Subgroups

4.1 Definition and Examples; (Permutation as composition of function)

4.2 Definition of S_n and discussion of S_3 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 A_n.

4.7 $\frac{Sn}{A_n} \simeq \{-1, 1\}$

Chapter- 5:- Sylow's theorems

5.1. Class Equations

5.1.1. Conjugate of an element- Definition & Examples

5.1.2. Conjugacy relation is and equivalence relation, Conjugacy Class

5.1.3. Normaliser, Centraliser, Center of a group.

5.1.4. Class equation

5.1.5. 'a 'belongs to Z(G) iff N (a) = G

5.1.6. Centre of a p-group is nontrivial.

5.1.7. Every group of order p-square is abelian.

5.2. Cauchy's theorem (Statements only)

5.3. Sylow's theorems (without proofs) only problems.

Chapter- 6:- Normal Subnormal Series of Groups

6.1. Subnormal & Normal Series- Definitions & Examples

6.2. Jordan Holder theorem – statement only

6.3. Solvable Series, Solvable Groups- Definitions and Examples

Chapter- 7:- Rings

7.1. Definitions & Examples

7.2. Simple Properties of Rings.

7.3.Commutative ring, ring with unity, integral domain, field, skew field definitions, examples and interrelationships between them.

7.4. Subrings- Definition, Examples, Properties.

7.5. Characteristic of an integral domain.

Chapter- 8:- Ideals & Quotient Rings

8.1. Definitions & Examples

8.2. Properties of ideals

8.3. Prime Ideals, Maximal Ideals.

8.4. Quotient rings

Chapter- 9:- Homomorphism & Isomorphism of rings

9.1. Definitions & Examples

9.2. Properties of ring homomorphisms

9.3.Fundamental theorem of ring homomorphisms & its applications.

Chapter- 10:- Euclidean Rings

10.1. Definitions & Examples

10.2. Properties

10.3. Polynomial ring F[x} over a field F.

10.4. F [x] is a Euclidean Ring.

10.5. Irreducible polynomials over a field

10.6. Polynomials over the field of rationals

10.6.1. Gauss lemma

10.6.2. Eisensteins criterion for irreducibility

Text Books:-

1) I. N. Herstein- Topics in Algebra, Macmillan Indian Edition
2) J.B. Fraleigh – Abstract Algebra, 5^{th} edition
3) K. Hoffmann R Kunze; Linear Algebra, PHI
4) S. Gopalkrishanan, Algebra

MIM 103 Discrete Mathematical Structures-I

1. **Formal Logic :**.

   1.1 Logic: Introduction, Proposition, Simple proposition, Compound proposition, Truth value, Prepositional Calculus, operators, Conjunction, Disjunction, Conditional statement, Biconditional statement, converse, contra positive and Inverse, Precedence of logical operators, Translating in English sentences into symbolic form logical implication.

   1.2 Propositional Equivalences: Introduction, Logical equivalences, Tautology, Contradiction, Logic rules.

   1.3 Predicates and Quantifiers: Introduction, Universal quantifier, existential quantifier, counter example, binding variables, negating quantifiers, translating sentences into logical expressions, nested quantifier, order of quantifiers, truth value of quantifier.

   1.4 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 Coefficients.

   Inclusion-Exclusion and Applications of Inclusion-Exclusion.

3. **Semigroups and Monoids:**

   Semigroup: Introduction examples, free semigroup, monoid, subsemigroup, submonoid.

   Isomorphism and homomorphism of semigroups and monoids.

   Product and quotients of semigroups, natural homomorphism, fundamental theorem of homomorphism.

4. **Lattices:**

   Lattices Introduction: Partial order, Hasse diagram, join and meet operation, chain, examples, product of lattices, laws of lattices, Idempotency, Commutativity, Associativity, Absorption. Principal of duality Types of lattices, Complete, distributive, bounded, Modular sublattices, complementary lattice, unique complement, relative complement. Quotient lattices.

5. **Boolean Algebra**

Introduction, Boolean expressions and Boolean function, Boolean identities, principle of duality.

Sum of products expansions: Literal, minterm, disjunctive normal form, c conjunctive normal form,

Logic Gates: Introduction, OR gate, AND gate, circuit diagram, full adder, half adder.

Minimization of circuits: Introduction, Karnaugh map, (2 variables, 3 variables), Prime implicant, essential prime implicant, Quine-McCluskey Method, minterm, bit string, cover,

Text Books:

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

   Chapter 10.

2. **Kolman, Busby, Ross and Rehman : Discrete Mathematical Structures, Pearson Education, Fifth Edition**

   Chapter 9 Section 9.1, 9.2, 9.3

3. **Vijay Khanna : Lattices and Boolean Algebra, Vikas Publication**

   Chapter 2 (Thm 2.5, 2.6, 2.7, 2.8, 2.9, 2.11) complete lattices, sublattices.

   Chapter 3 Complements (Thm 3.17, 3.18) Homomorphisms (Thm 3.20, 3.21, 3.23, 3.27, 3.29).

   Chapter 4 (Thm 4.1, 4.2, 4.3) Distributive lattice (Thm 4.11, 4.12, 4.13, 4.14, 4.15) 'Principle of duality'.

Reference Books:-

(1) Applied Abstract Algebra by Rudolf Lid1 and Gunther Pilz, 2nd edition (Springer),

(2) Discrete Mathematics by Lipschutz (Schaum's Series).

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, float, 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

6.4 User 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, argumented 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

1.5 History of computers

1.6 Types of computers

2. Input –Output Devices

2.1 Introduction

2.2 Input Devices

2.3 Output Devices

3. Data Representation

3.1 Representation of data

3.2 Types of number systems

3.3 Need for binary systems

3.4 Representation of characters

3.4.1 The ASCII code

3.4.2 The EBCDIC code

4. Computer memory and storage devices

4.1 What is a memory?

4.2 Primary memory

4.3 Cache memory

4.4 Secondary memory and Storage devices

5. Introduction to Operating systems

5.1 Concept of Software

5.2 Classification of software

5.3 What is Operating system(O.S.) ?

5.4 Services provided by operating system

5.5 Types of Operating Systems

5.5.1 Batch OS ,

5.5.2 Multiprogramming OS

5.5.3 Time sharing system

5.5.4 Real time system

5.5.5 Distributed system

6. File Organization

6.1 Introduction

6.2 Physical\Logical files

6.3 Special characters in files

6.4 Fields and record organization

6.4.1 Fixed length records

6.4.2 Variable length records

6.5 Types of file organization

6.6 Overview of Indexes

6.6.1 Dense Index

6.6.2 Sparse Index

6.6.3 Clustered / Unclustered indexes

6.6.4 Tree structured indexing

ISAM

B+ tree index

7. Computer Networking

7.1 Communication

7.1.1 Concept of communication

7.1.2 Communication media

7.2 Networking

7.2.1 Network Goals

7.2.2 Applications of networks

7.2.3 Types of Networks

7.2.4. Topologies

7.2.5. Components of networks

7.2.6 Protocols

7.2.7 World Wide Web(WWW)

References :

1. V. Rajaraman : Fundamentals of Computers
2. Raghuramakrishnan : Database Systems
3. Henry Korth : Database Systems
4. Nawathe : Database Systems
5. Andrew N. Tanenbaum : Computer Networks
6. Silbertz, Korth : Operating System Concepts

MIM 106 Lab Work

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 sinx and cosx series.
6. Write a menu driven program to multiply and subtract and 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 upto 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 fields: - 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 mXn using dynamic memory allocation.
12 Write a C program to create a file and count the number of words, lines and characters in the file.
13. Write a C program to encrypt /decrypt the contents of a file using command line arguments.

MIM - 201 Real and Complex Analysis

Section I: Lebesgue Theory

Topic 1: Lebesgue Theory

1.1 Introduction

1.2 Outer measure: Definition and properties

1.3 Measurable sets and Lebesgue measure: Definition and properties

1.4 Non- measurable set: example

1.5 Measureable functions: properties

1.6 Littlewood's three principles

Text Book: Real Abalysis, H. L. Royden, PHI (third edition)

Chapter 3 Art. 1-6

The Lebesgue Integral

1.7 The Riemann Integral

1.8 The Lebesgue Integral of a bounded function over a set of finite measure:

1.8.1 Definition and properties

1.8.2 Bounded convergence theorem

1.9 The integral of a non-negative function

1.9.1 Properties

1.9.2 Fatou's lemma

1.9.3 Monotone convergence theorem

1.10 The General Lebesgue Integral

1.10.1 Lebesgue convergence theorem

Text Book: Real Analysis, H. L . Royden, PHI (Third Edition)

Chapter 4 Art. 1-4

Section II Complex Analysis

Topic 1: Complex Numbers: Revision (no questions on this portion be asked)

1.1 Definition of complex numbers and properties

1.2 Geometric interpretation

1.3 Topology of the complex plane

Topic 2 : Analytic fuctions

2.1 Fuctions ,limits and continuity: Definition and properties

Text Book: Foundations of Complex Analysis, S. Ponnusamy, Narosa, (4th reprint 2002) Art. 2.1: Definition 2.1, 2.2, examples, definitions 2.3, 2.4, 2.5, 2.6, Theorem 2.1, Theorem 2.2 (Statement only), Definition 2.7, 2.8,2.9,2.10 with examples, Theorem 2.3,2.4,2.5, Theorem 2.6 (Statement only)

2.2 Differentiability: Definition and properties,

Text Book: Foundations of Complex Analysis, S. Ponnusamy, Narosa (4th reprint 2002) Art 2.2 : Definition 2.14,2.15,2.16, Definition 2.16,2.17,2.18 Theorem 2.17,2.18,2.19,2.20, Definition 2.19,2.20,2.21,2.22 Theorem 2.23

2.3 Power Series as an Analytic function

2.3.1 Definition of power series, radius of convergence, Root test (Statement Only) Examples for finding radius of convergence, Taylor series and Maclaurin series

Text Book: Foundation of Complex Analysis, S. Ponnusamy, Narosa (4th reprint 2002) Art 2.3 Definition 2.24, Theorem 2.25, 2.26, 2.27, 2.28 (Statement of these theorems only)

2.4 Zeros of an analytic function

Theorem 2.37 of Art 2.7

3. Complex Integration

3.1 Curves in the complex plane

3.2 Basic properties of complex integral

3.3 Winding number or index number

3.4 Cauchy – Goursat theorem (Statement only)

3.5 Homotopy and homotopy version of Cauchy's theorem (Statement of theorem only)

3.6 Morera's theorem

3.7 Cauchy's integral formula

3.8 Taylor's theorem, Cauchy's inequality, Laurent series

3.9 Maximum modulus principle and maximum modulus theorem

3.10 Cross ratio, Mobius trasformation

3.11 Liouville's theorem

Text Book :

S. Ponnusamy : Foudations of Complex Analysis, Narosa, (4th reprint2002)

Art 3.1: Definition 3.1,3.2

Art 3.2 : Definition 3.3,3.4,3.5, Theorem 3.1, Definition 3.6, Theorem 3.2, Corollary 3.1, Theorem 3.3 and it's corollaries

Art 3.3 : Definition 3.7, theorem 3.4, Theorem 3.5, 3.6

Art 3.4 : Theorem 3.9 (Statement only)

Art 3.5 : Theorem 3.13, Theorem 3.14 (Statement only)

Art 3.6 : Theorem 3.15

Art 3.7 : Theorem 3.16, 3.17, Theorem 3.18, 3.19 (Statement only), Theorem 3.22, Corollary 3.16, Theorem 3.25

Art 3.8 : Definition 3.14, Theorem 3.14, Theorem 3.28 corollary 3.17

Art 3.9 : Definition 3.15, Theorem 3.31, Theorem 3.33, Definition 3.16, 3.17, 3.18 Theorem 3.40, corollary 3.21

Art 3.11 Theorem 3.45, Theorem 3.47, corollary 3.24

4. Classification of Singularities

4.1 Isolated and non-isolated singularities

4.2 Removable singularities

4.3 Poles

Text Book: S. Ponnusamy: Foundations of Complex Analysis, Narosa, (4th reprint 02)

Art 4.1: Definition 4.1: Definition 4.1 and examples.

Art 4.2 : Definition and Examples, Theorem 4.1 (Statement only)

Art 4.3 : Definition and examples

5. Calculus of Residues

5.1 Residue at finite point

Text Book: S. Ponnusamy: Foundations of Complex Analysis, Narosa, (4th reprint 02)

Art : Examples

5.2 Cauchy's residue theorem and evaluation of integrals using it

5.3 Rouche's theorem

Text Book: S. Ponnusamy: Foundations of Complex Analysis, Narosa, (4th reprint)

Art 501, Theorem 501, 5.2, 5.3, 5.4, 5.6, 5.7 (Statement only), Theorem 5.10, 5.11, 5.15

MIM 202 – Algebra II

Chapter 1 : - Vector Spaces

1.1 Definitions & Examples

1.2 Simple properties of Vector Spaces

1.3 Subspaces: Definition, Examples, Necessary and sufficient conditions

1.4 Sum, Direct sum, Intersection of Subspaces

1.5 Quotient Space

1.6 Liner Span: Definition & Properties

1.7 Liner Dependence & Independence – Definition examples & Props

1.8 Basis and dimension of vector Space, Dimension of subspaces, Dimension of Quotient space

1.9 Coordinates relative to a basis coordinate vector, coordinate matrix

Chapter – 2 : - Linear Transformations

2.1 Definition, 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

2.6 Dual Spaces, Dual Basis

Chapter – 3 : - Eigenvalues & Eigenvectors of a Linear Transformation

3.1 Definition and Examples

3.2 Eigenvalues & Eigenvectors of a sq matrix

3.3 Properties – Cayley Hamilton theorem

3.4 Diagonalization

3.5 Annilator of a subspace Definition and Examples

Chapter – 4 : - Inner Product Spaces

4.1 Definition & Examples, properties

4.2 Cauchy Schwartz inequality

4.3 Orthonormal vectors, Orthogonal Complements

4.4 Orthonormal sets and bases

4.5 Gram Schmidt orthogonalization process

Chapter – 5 Modules

5.1 Definition & Examples, Properties

5.2 Submodules

5.3 Quotient Modules

5.4 Homomorphism & Isomorphism theorems

Chapter – 6 Extension Fields

6.1 Introduction to Extension Fields

6.2 Vector Spaces

6.3 Algebraic Extensions

Finite Fields

Chapter – 7 Automorphisms & Galois Theory

7.1 Automorphisms of Fields

7.2 The Isomorphism Extension theorem

7.3 Splitting Fields

7.4 Separable Extensions

7.5 Totally Inseparable Extensions

7.6 Galois Theory

Text Books:

1. I. N. Herstein: Topics in Algebra, Macmillan Indian Edition
2. J. B. Fraleigh: Abstract Algebra, 5^{th} Edition
3. K. Hoffmann R Kunze, Linear Algebra PHI
4. S. Gopalakrishanan: Algebra

MIM 203 Discrete Mathematical Structures-II

Graph Theory

1. **Graph:** Definition, Vertex, Edge, Terminal vertices , self loop, incidence, adjacency finite, Infinite 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 cutest, 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 graph definition:** Incident out of a vertex, incident into a vertex, indegree, outdegree, isolated vertex, pendant vertex, Types of digraphs, Simple Asymmetric, Symmertic, complete, Complete symmetric digraph, complete asymmetric digraph, Arborercence 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, 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]

12. **Coloring:**

    Vertex Coloring: K-coloring, K-colourable, Chromatic Number, K-Chromatic.
    Vertex colouring Algorithm: Simple Sequential Colouring, Largest–First Sequential Algorithm (Welsh and Powell) Smallest–Last Sequential Algorithm.
    Edge Colouring: Definition and Concept Only.
    [Ch-6 of Graph Theory by John Clark and Allan Holton Section 6.1, 6.2, 6.5.]

Text Books:

1. N. Deo : Graph Theory with Applications to Comp. Sc. and Engineering. PHI Publication.
2. John Clark and Allan Holton : Graph Theory.

Reference Books:

1. Douglas B. West : Introduction to Graph Theory, 2nd Edition, Pearson Education.

MIM-204 :Database Fundamentals

1. **Introduction of DBMS**

   Overview, File system Vs DBMS, Describing and storing data (Data models (relational, hierarchical, network)), Levels of abstraction , data independence,

   Queries in DBMS (SQL : DDL, DML,DCL,TCL), Structure of DBMS, People who deal in DBMS, Advantages of DBMS

2. **Conceptual Design (E-R model)**

   Overview of DB design, ER data model (entities, attributes, entity sets, relations, relationship sets) , Additional constraints (key constraints, participation constraints, weak entities, aggregation / generalization, conceptual design using ER (entities VS attributes, Entity Vs relationship, binary Vs ternary, constraints beyond ER), Conceptual design for small to large enterprises, Case studies .

3. **Relational data model**

   Relations (concepts, definition), Conversion of ER to Relational model , integrity constraints (key, referential integrity, general constraints)

4. **Relational algebra**

   Preliminaries, Relational algebra (selection, projection, set operations, renaming, joins, division)

5. **Relational calculus**

   Tuple calculus, Calculus Versus Relational algebra

6. **SQL**

   DDL (create, drop, alter), forms of a basic SQL query (egs, expressions, strings in SQL), union / intersection / except, nested queries(introduction, correlated queries, set comparison operators), Aggregate operators (group by, having), aggregate functions, Null values (comparison using NULL, logical connections (AND,OR,NOT) impact on SQL commands, outer joins, disallowing NULL), examples on SQL (case studies) , Creating functions in PLSQL, cursors, triggers

7. Functional dependency

Introduction to schema refinement (problems caused by redundancy, use of decomposition, Problems related to decomposition, functional dependencies(definition, closure (F+, (attribute)+),loss less-join decomposition.

Normalization & it's forms (1NF, 2NF, 3NF, BCNF)

References :

1. Raghuramakrishnan : Database Systems
2. Henry Korth : Database Systems
3. Nawathe : Database Systems
4. C.J.Date : An Introduction to Database Systems (Pearson education 7th edition)
5. Bipin Desai : Introduction to Database Systems (Asian Students edition)
6. Postgresql , O'Reilly publications

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: Lab Work

Assignment list

1. Infix to postfix (fully parenthesized)
2. Evaluation of postfix expression
3. Implementation of reservation system using queues
4. Merging of two linked lists
5. Creation of binary search tree of integers and displaying its traversals
6. To count the number of steps of quick sort and merge sort
7. Conversion of adjacency matrix to adjacency list and calculate in degree and out degree of each vertex of the graph
8. Assignments related to SQL (DML, DDL statements)
   Each assignment will contain 2 to 3 small case studies to create relations with specified constraints & insert records to it & query on it.
9. 3 to 4 Assignments on PL/Pgsql (creating simple functions, functions demonstrating use of cursors, creating & demonstrating the use of database triggers)