Deccan Education Society's

FERGUSSON COLLEGE, PUNE
(AUTONOMOUS)

SYLLABUS UNDER AUTONOMY

FIRST YEAR M.Sc.
(Industrial Mathematics with Computer Applications)

SEMESTER – I

SYLLABUS FOR M.Sc. - I
(Industrial Mathematics with Computer Applications)

Academic Year 2016-2017

Deccan Education Society's
FERGUSSON COLLEGE, PUNE
Scheme of Course Structure
(Faculty of Science)
Department of Mathematics
M. Sc. (IMCA)

	Name of the paper	Code	Title of Paper	No of Credits
M Sc (IMCA) Semester I	Theory Paper -I	MTS4101	Real Analysis	4
	Theory Paper -II	MTS4102	Linear Algebra	4
	Theory Paper -III	MTS4103	Discrete Mathematical Structures	4
	Theory Paper -IV	MTS4104	C Programming	4
	Theory Paper -V	MTS4105	Database Management Systems	4
	Practical Paper -I	MTS4106	Practical - I based on C programming and Database Management Systems	4
	Practical Paper -II	MTS4107	Practical - II Programming Skills	1
M Sc (IMCA) Semester II	Theory Paper - I	MTS4201	Complex Analysis	4
	Theory Paper -II	MTS4202	Group Theory and its Applications	4
	Theory Paper -III	MTS4203	Numerical Analysis	4
	Theory Paper -IV	MTS4204	C++	4
	Theory Paper -V	MTS4205	Data Structures Using C	4
	Practical Paper -III	MTS4206	Practical - III based on Data Structures using C and C++	4
	Practical Paper -IV	MTS4207	Practical - IV Mini project based on C programming and Database Management Systems	1

Particulars	Name of the paper	Code	Title of Paper	No of Credits
M Sc (IMCA) Semester I	Extra Credit Course	XHR0001	Human Rights - I	1
	Extra Credit Course	XCS0002	Introduction to Cyber Security - I	1
	Extra Credit Course	XSD0003	Skill Development - I (Introduction to LaTeX)	1
M Sc (IMCA) Semester II	Extra Credit Course	XHR0004	Human Rights - II	1
	Extra Credit Course	XCS0005	Introduction to Cyber Security - II	1
	Extra Credit Course	XSD0006	Skill Development - II (Scilab-I)	1

MTS4101 Real Analysis

1 **Metric Spaces and its Topology** (8 Lectures)

(a) Metric Spaces Definition and Examples, k-cells, convex sets, open closed ball, properties
(b) Definition : Neighborhood, limit point, isolated points, closed sets, interior points, open sets, perfect sets bounded sets, dense sets, examples and properties.
(c) Definition: Open cover, compact sets, examples and properties. Theorem of Weierstrass
(d) Connected sets, definition of separated sets, connected sets and properties

2 **Numerical Sequences and series** (10 Lectures)

(a) Convergent Sequences, Definition and Examples properties
(b) Sub sequences: Definition and properties
(c) Cauchy Sequences: Definition, Examples and properties, Definition of complete metric space, examples, Definition of Monotonic Sequences and its properties
(d) Upper and lower limits, Definition, examples and properties
(e) Convergence of some special sequences
(f) Series: Definition, examples and properties, series of non-negative terms, Cauchys condensation test and examples
(g) The Number e
(h) Root and ratio tests, examples
(i) Power series, Definition, radius of Convergence, examples and properties
(j) Summation by parts, absolute convergence

3 **Continuity** (6 Lectures)

(a) Limits of functions: Definition, examples and proper-ties
(b) Continuous functions, Definition, examples and properties
(c) Continuity and Compactness, Bounded Set: Definition ,Continuous image of a compact set is compact and related properties, Definition of Uniform Continuity and related properties
(d) Continuity and Connectedness: continuous image of connected set is connected and related properties
(e) Discontinuities, Definition, examples
(f) Monotonic functions, Definition examples and properties

4 **Differentiation** (8 Lectures)

(a) Derivative of a real function, Definition examples and properties
(b) Mean Value Theorem
(c) Continuity of derivatives
(d) Taylor's theorem
(e) Differentiation of a vector valued function.

5 **Riemann Stieljes Integral** (10 Lectures)

(a) Definition and existence of the integral, related properties
(b) Properties of Integral
(c) Integration and differentiation
(d) Integration of vector valued functions

6 **Sequences and series of function** (8 Lectures)

(a) Discussion of main problem with examples
(b) Uniform convergence: Definition and properties
(c) Uniform convergence and continuity
(d) Uniform convergence and integration
(e) Uniform convergence: and differentiation

Reference Books

(1) Walter Rudin: Principles of Real Analysis, (3rd Edition, Tata McGraw Hill Publication)
(2) Alphrantis and Birkinshaw : Principles of Real Analysis
(3) R G Bartle : Real Analysis (John and Wiley Publications)
(4) Kenneth Davidson and Allan P Donsing : Real Analysis and its Applications (Springer Science)

(5) Balmohan Limaye and Sudhir Ghorpade : A Course in Calculus and Real Analysis (Springer Science)

MTS4102 Linear Algebra

(1) **Vector Spaces** (10 Lectures)
- (a) Definitions & Examples, Simple properties of Vector Spaces
- (b) Subspaces: Definitions, Examples, Necessary and Sufficient conditions
- (c) Sum, Intersection of Subspaces, Quotient Space.
- (d) Linear Span: Definitions & Properties, Linear Dependence & Independence: Definitions, examples & properties
- (e) Basis and dimension of a vector space, Dimension of subspaces, Dimension of quotient space
- (f) Coordinates relative to a basis, coordinate vector, coordinate matrix

(2) **Linear Transformations** (6 Lectures)
- (a) Definitions, Examples and Simple properties
- (b) Representation of a linear transformation as a matrix, change of basis
- (c) Rank-Nullity theorem
- (d) Algebra of linear transformations

(3) **Eigen values & Eigenvectors of a Linear Transformation** (6 Lectures)
- (a) Definitions and Examples
- (b) Eigen values & Eigen vectors of a square matrix
- (c) Properties, Cayley Hamilton theorem
- (d) Diagonalization

(4) **Inner Product Spaces** (6 Lectures)
- (a) Definitions & Examples, properties
- (b) Cauchy-Schwarz inequality
- (c) Orthonormal vectors, Orthogonal Complements
- (d) Orthonormal sets and bases
- (e) Gram Schmidt orthogonalization process

(5) **Two-dimensional Transformations** (8 Lectures)
- (a) Representation of Points, Transformations and Matrices, Transformation of Points
- (b) Rotation, Reflection, Scaling, Combined Transformations, Transformation of the Unit Square, Solid Body Transformation, Rotation, reflection and scaling as linear transformations.
- (c) Translations and Homogeneous Coordinates, Rotation About an Arbitrary Point, Reflection through an arbitrary Line
- (d) Projection - A Geometric Interpretation of Homogeneous Coordinates, Overall Scaling, Points at Infinity, Transformation Conventions.

(6) **Three Dimensional Transformations** (8 Lectures)
- (a) Three-Dimensional Scaling, Three-Dimensional Shearing,Three-Dimensional Rotation, Three-Dimensional Reflection, Three-Dimensional Translation.
- (b) Multiple Transformations,
- (c) Rotations about an Axis Parallel to a coordinate axis, Rotation about an Arbitrary Axis in space
- (d) Reflection through an Arbitrary Plane. Affine and Perspective Geometry,
- (e) Orthographic Projections, Axonometric Projections, Oblique Projections, Perspective Transformations.
- (f) Techniques for generating perspective views, Vanishing points

(7) **Plane Curves** (6 Lectures)
- (a) Curve representation, non-parametric curves, parametric curves
- (b) Parametric representation of a circle, parametric representation of an Ellipse, parametric representation of a parabola, parametric representation of a Hyperbola.
- (c) A procedure for using conic sections. The general conic equations.

Reference Books

(1) Gilbert Strang: Linear Algebra and its applications (Fourth edition)
(2) K. Hoffman and Ray Kunje : Linear Algebra (Prentice -Hall of India private Ltd.)

(3) D.F. Rogers, J. Alan Adams : Computer Graphics, Second Edition McGraw-Hill Publishing Company.
(4) M. Artin : Algebra (Prentice -Hall of India private Ltd.)
(5) A.G. Hamilton : Linear Algebra (Cambridge University Press),1989.
(6) N.S. Gopala Krishnan : University algebra (Wiley Eastern Ltd.).
(7) J.S. Golan : Foundations of linear algebra (Kluwer Academic publisher),1995.
(8) Henry Helson : Linear Algebra, (Hindustan Book Agency), 1994.
(9) I.N. Herstein : Topics in Algebra, Second edition, (Wiley Eastern Ltd.)
(10) David Lay : Linear Algebra Mathematical Elements of Computer Graphics,

MTS4103 Discrete Mathematical Structures

(1) **Formal Logic** (6 Lectures)

(a) Logic :Introduction, Proposition, Simple proposition, Compound proposition, Truth value, Prepositional Calculus, operators, Conjunction, Disjunction, Conditional statement, Bi conditional statement, converse, contra positive and Inverse.

(b) Predicates and Quantifiers: Introduction, Universal quantifier, existential quantifier, counters examples, negating quantifiers, nested quantifier, order of quantifiers, truth value of quantifier.

(c) 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** (4 Lectures)

(a) The Basic of Counting, the Pigeonhole Principle, Inclusion Exclusion Principle and Applications of Inclusion-Exclusion

(3) **Combinatorics** (10 Lectures)

(a) Combination, Permutation, Generating Functions, Ordinary and Exponential Generating functions

(b) Recurrence Relation, Methods of Solution of Recurrence Relation, Substitution Method, Characteristic Method, Generating Function Method.

(4) **Graph Theory**

(a) Introduction to Graphs: (8 Lectures)
Definition of graph, Vertex, Edge, Terminal vertices self loop, Graphs as a models.Definition, 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. Isomorphism, Examples,Subgraph, Operations on graphs (Union, Intersection, ring- sum, sum of 2 graphs, fusion, Deletion of a vertex (edge), Decomposition of a graph, joint) Walk, path, cycle, component, trail (Theorems on the topic) Matrix Representation: Incidence matrix, adjacency matrix, properties. Fusion of Graphs and corresponding algorithms.

(b) Connected graph: (6 Lectures)
Definitions and simple Properties, Pendant vertex in a tree, Distance and Centres in a tree. Rooted and binary trees, spanning trees, rank nullity Bridges and corresponding Theorems.Spanning trees and corresponding theorems, weighted graph, Kruskal's algorithm, Prims algorithm.Shortest path problems and Graph theoretic algorithms:Dijkstra's algorithm, Warshall Floyd algorithm, Depth first, Breadth first search algorithm.Cut vertices and connectivity, vertex connectivity, edge connectivity

(c) Euler graph: (4 Lectures)
Definition examples of an Eulerian graph. Chinese postman problem(as an application of graphs), Fleurys algorithm.(Theorems on the topic) Definition and examples of Hamiltonian graphs

(d) Huffman Coding: (2Lectures)

(e) Colouring: (6Lectures)
Vertex colouring,Vertex colouring algorithms ,Applications of vertex colouring 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

(f) Networks: (4 Lectures)
Flows and cuts,Max flow and min cut theorem,The Ford and Fulkerson Algorithm

Reference Books

(a) K.H. Rosen : Discrete Mathematics and its Applications (TATA McGraw-HILL), 5th Edition

(b) John Clark and Allan Holton : Graph Theory

(c) Alan Tucker : Applied Combinatorics, Forth Edition (John Willey).

(d) N. Deo : Graph Theory with Applications to Comp. Sc. and Engineering. PHI Publication.

(e) Kolman, Busby, Ross : Discrete Mathematical Structures,Fifth Edition (Pearson Education).

(f) Purna Chandra Biswal : Discrete Mathematics and Graph Theory, Second Edition (PHI.).

MTS4104 C Programming

(1) **Programming languages** (1 Lecture)
- (a) Machine language
- (b) Assembly language
- (c) High level languages
- (d) Compilers and Interpreters

(2) **Introduction to C** (1 Lectures)
- (a) History
- (b) Structure of a C program
- (c) Functions as building blocks
- (d) Application Areas
- (e) C Program development life cycle

(3) **C Tokens** (8 Lectures)
- (a) Keywords
- (b) Identifiers
- (c) Variables
- (d) Constants character, integer, oat, string, escape sequences
- (e) Data types built-in and user defined
- (f) Operators and Expressions: Operator types (arithmetic, relational, logical, assignment, bitwise, conditional, other operators), precedence and associativity rules.

(4) **Input and Output** (4 Lectures)
- (a) Character input and output
- (b) String input and output
- (c) Formatted input and output.

(5) **Control Structures** (5 Lectures)
- (a) Decision making structures: If, if-else, switch
- (b) Loop Control structures: While, do-while, for
- (c) Nested structures
- (d) break and continue

(6) **Functions in C** (6 Lectures)
- (a) What is a function?
- (b) Advantages of Functions
- (c) Standard library functions
- (d) User defined functions: Declaration, definition, function call, parameter passing (by value), return keyword
- (e) Scope of variables, storage classes
- (f) Recursion

(7) **Arrays** (4 Lectures)
- (a) Array declaration, initialization
- (b) Types one, two and multidimensional
- (c) Passing arrays to functions

(8) **Pointers** (6 Lectures)
- (a) Pointer declaration, initialization
- (b) Dereferencing pointers
- (c) Pointer arithmetic
- (d) Pointer to pointer
- (e) Arrays and pointers
- (f) Functions and pointers passing pointers to functions, function returning pointers, pointer to function
- (g) Dynamic memory allocation

(9) **Strings** (3 Lectures)

(a) Declaration and initialization
(b) Standard library functions
(c) Strings and pointers
(d) Array of strings.

(10) **Structures and Unions** (4 Lectures)
(a) Creating structures
(b) Accessing structure members (dot Operator)
(c) Array of structures
(d) Passing structures to functions
(e) Nested structures
(f) Pointers and structures
(g) Unions
(h) Difference between structures and unions

(11) **C Pre-processor** (2 Lectures)
(a) Format of Pre-processor directive
(b) File Inclusion directive
(c) Macro substitution, nested macro, argument macro
(d) Conditional compilation

(12) **Command Line Arguments** (1 Lectures)
(a) Accessing command line arguments

(13) **File Handling** (3 Lectures)
(a) Streams
(b) Types of Files
(c) Operations on files
(d) Random access to files

Reference Books

(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

MTS4105 Database Management Systems

(1) to Database Systems (6 Lectures)

(a) Introduction, Basic Concepts and Definition, Data, Information, Data versus Information, Data warehouse
(b) Metadata
(c) Data Item or Field, Records, Data Dictionary,
(d) Database, Database System
(e) Database Users and Database Administrator, Functions and Responsibilities of DBA, File-oriented System versus Database System, View of Data
(f) Database Languages
(g) Schemas, Sub-schemas and Instances
(h) 3-Level Architecture:-
  (i) Internal Level
  (ii) Conceptual Level
  (iii) External Level
(i) Data Independence
  (i) Physical Data Independence
  (ii) Logical Data Independence
(j) Structure of a DBMS, Functions of DBMS, Data Models

(2) **Physical Data Organization** (3 Lectures)

(a) Introduction, Physical Storage Media,RAID Technology,
(b) Basic concepts of File
  (i) File Types
  (ii) Buffer Management
  (iii) File organization
(c) Indexing

(3) **Relational models** (7 Lectures)

(a) Introduction, Structure of Relational Database
(b) Relational Algebra
  (i) Selection Operation, Projection Operation, Union Operation, Cartesian Product Operation, Intersection Operation
  (ii) Difference Operation, Division Operation, Rename Operation, Join operation
(c) Relational Calculus:- Tuple Relational Calculus
(d) Relational Algebra Vs Calculus

(4) **4 Databases and Relational Database Design** (8 Lectures)

(a) Introduction, Basic E-R Concepts, keys, Constraints
(b) Entity Set
  (i) Strong Entity Set
  (ii) Week Entity Set
(c) E-R Diagram Symbol, E-R Diagram, Extended E-R Features, Conversion of E-R Model into Relations
(d) Functional Dependency, Full Functional Dependency, Armstrongs Axioms, Redundant Functional Dependencies, Closures of a set of Functional Dependencies
(e) Decomposition, Normalization
(f) Normal forms
  (i) First Normal Form, Second Normal Form, Third Normal Form, Boyce-Codd Normal Form (BCNF), Fourth Normal Form, Fifth Normal Form

(g) **SQL** (8 Lectures)
  (i) Introduction, Basic Structure, Aggregate Functions, Null Values
  (ii) Nested Subqueries, Views, Complex Queries
  (iii) Modification of Database
  (iv) Integrity and Security Constraints, Security and Authorization
  (v) Triggers and Cursors

(h) **Transaction Management** (6 Lectures)

(i) Transaction Concepts, Transaction Properties, Transaction States, Concurrent Execution
(ii) Serializability
(iii) Recoverability

(i) **Concurrency Control and Database Recovery System** (6 Lectures)
(i) Introduction
(ii) Lock based Protocols
(A) Locks, Granting of locks
(B) Two Phase Locking Protocol, Time Stamp-Based protocol
(C) Thomas Write Rule
(D) Multiple Granularity
(E) Deadlock Handling
(iii) Database Recovery Concepts, Types of Database Recovery
(iv) Recovery Technique
(A) Deferred Update, Immediate Update
(v) Buffer Management

(j) **NOSQL** (4 Lectures)

Reference Books

(a) Singh : Database Systems: Concepts, Design and Applications, ISBN: 9788131760925, Pearson
(b) Raghu Ramakrishnan, Johannes Gehrke: Database Management Systems, ISBN: 9780072465631, TMH
(c) Abraham Silberschatz, Henry Korth, S. Sudarshan : Database Systems Concepts, TMH
(d) Connolly: Database Systems, ISBN: 9788131720257, Pearson
(e) Levene : A Guided Tour of Relational Databases and Beyond, ISBN:9788181280510, Springer
(f) Gillenson : Fundamentals of Database Management Systems, ISBN:9788126517930, Wiley India
(g) C.J. Date : Database Design and Relational Theory ISBN:9789350237298,O'Reilly
(h) Date/Kanna : An Introduction to Database Systems, ISBN, 9788177585568 , Pearson
(i) Elmasri : Fundamentals of Database Systems, ISBN:9788131716250 , Pearson
(j) O'Neil : Database-Principles, Programming and Performance, ISBN:9789380501284, Elsevier
(k) Garcia-Molina : Database System Implementation, ISBN:9788131704134, Pearson

MTS4106 Practical - I

Practical - I: Based on C-Programming and Database Management systems.

MTS4107 Practical - II

Practical - II: Programming Skills

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MTS4201 Complex Analysis

(1) **Complex Numbers and Topology of Complex Plane** (1 Lecture)
   (a) Algebra of Complex Numbers, Roots of unity and related problems

(2) **Extended Complex Plane** (1 Lecture)
   (a) Stereographic Projection and Chordal metric (Introduction), Theorems and problems

(3) **Analytic Functions** (10 Lectures)
   (a) Functions, Limits and Continuity of Complex Valued Functions
   (b) Differentiability:Definition and properties
   (c) Complex Logarithms. Definition and its related problems. Zeros of an analytic functions and related examples

(4) **Complex Integration** (15 Lectures)
   (a) Curves in the complex plane
   (b) Basic properties of complex integral
   (c) Winding number or index number and its related theorems
   (d) Cauchy Goursat theorem (Statement only)
   (e) Homotopy and homotopy version of Cauchys theorem (Statement of theorem only)
   (f) Moreras theorem Theorem
   (g) Cauchy Integral formula Theorem and its related problems
   (h) Taylors theorem, Cauchys inequality, Laurent series and its related problems
   (i) Maximum modulus principle and maximum modulus theorem and its related problems
   (j) Schwarz Lemma, Mobius Transform, Cross Ratio (: Definition of Mobius Transform)
   (k) Liouvilles theorem and its Applications

(5) **Classification of Singularities** (10 Lectures)
   (a) Isolated and non-isolated singularities
   (b) Removable singularities and it related examples
   (c) Poles: Definition and examples
   (d) Essential Singularity and Casorati Weierstrass Theorem

(6) **Calculus of Residues** (12 Lectures)
   (a) Residue at Finite point
   (b) Cauchys residue theorem and evaluation of Real integrals
   (c) Argument Principle and Rouches theorem

Reference Books

   (a) S Ponnusamy : Foundations of Complex Analysis (Narosa Publishing House 4th Reprint)
   (b) Elais M Stein and Rami Shakarchi : Complex Analysis: (Princeton Lecture Series in Analysis)
   (c) John Conway : Functions of Complex Variable (Springer GTM Series)

MTS4202 Group Theory and its Applications

(1) **Groups** (5 Lectures)
   (a) Definitions and Examples, Simple properties of Groups based on axioms, Order of an Element Definition, properties and Examples

(2) **Subgroups** (4 Lectures)
   (a) Subgroups, Definition and Examples,
   (b) Necessary and sufficient conditions for a Subgroups, Properties of Subgroups

(3) **Cyclic groups** (4 Lectures)
   (a) Cyclic groups, Definitions and Examples,
   (b) Properties of cyclic Group.

(4) **Permutation groups** (4 Lectures)
   (a) Definition and Examples, Permutation as composition of function, Definition of S_n and discussion of S_3 in detail, Cycles, Transpositions, Every Permutation is a product of disjoint cycles
   (b) Even and odd permutations, order of a permutation, Alternating group A_n.

(5) **Homomorphism and Isomorphism** (5 Lectures)
   (a) Definitions and Examples, Simple Properties
   (b) Isomorphism - Definition and Examples
   (c) Fundamental theorem of homomorphism and its applications
   (d) Cayleys theorem

(6) **Cosets and Langrange theorem** (4 Lectures)
   (a) Cosets - Definition, Examples and Properties
   (b) Lagranges theorem and its corollaries

(7) **Normal Subgroups** (6 Lectures)
   (a) Definition and Examples, Properties of Normal Subgroups
   (b) Simple Groups, A_n is Simple for n = 5 (without proof)
   (c) Factor Group, Definition and Examples, Properties of Factor groups

(8) **Sylows theorems** (6 Lectures)
   (a) Class Equations, Conjugate of an element-Definition and Examples, Conjugacy relation is and equivalence relation, Conjugacy Class
   (b) Normalizer, Centralizer, Center of a group, Class equation, a belongs to $Z(G)$ iff $N(a) = G$, Center of a p-group is nontrivial.
   (c) Every group of order p-square is abelian.
   (d) Cauchys theorem (Statements only)
   (e) Sylows theorems (without proofs) - only problems.

(9) **Symmetry Groups** (4 Lectures)
   (a) Isometries
   (b) Classification of Finite Plane symmetry
   (c) Classification of Finite Groups of Rotations in R3

(10) **Symmetry and Counting** (5 Lectures)
   (a) Introduction, Burnsides Theorem, Applications of Burnside Theorem
   (b) Group Action

(11) **Intoduction to Algebraic Coding Theory** (4 Lectures)
   (a) Linear codes, Parity check matrix
   (b) Decoding, coset decoding.

Reference Books

(1) Joseph Gallian : Contemporary Abstract Algebra (Fourth Edition, Narosa Publication)

(2) J.B. Fraleigh : Abstract Algebra, 5th edition
(3) I.S. Luthar and I.B.S. Passi : Algebra (Volume 1) Groups (Narosa Publishing House)
(4) I.N. Herstein : Topics in Algebra (Wiley -Eastern Ltd)
(5) M. Artin : Algebra (Prentice Hall)
(6) N.S. Gopala Krishnan : University Algebra (Wiley-Eastern Ltd)
(7) Fraleigh : A First Course in Abstract Algebra
(8) Dummit and Foote : Abstract Algebra (Wiley-Eastern Ltd)

MTS4203 Numerical Analysis

(1) **Review of Calculus, Error Analysis** (1 Lecture)
   (a) Mean Value Theorems, Error Term in Taylor Series, Big O notation

(2) **Solutions to Linear and Non Linear Equations** (8 Lecture)
   (a) Iteration for solving $x = g(x)$ (Fixed Point Iterative Method)
   (b) Bracketing method of locating roots (Bisection Method)
   (c) Initial Approximation and convergence Criteria
   (d) Newton Raphson and Secant Methods
   (e) Mullers Method (Non Linear Method for tracing of Roots)

(3) **Solutions to Linear Systems** $AX = B$ (7 Lecture)
   (a) Triangular Factorization
   (b) Iterative method to Linear Systems (Jacobi and Gauss Seidel Methods)
   (c) Iteration for Non Linear System : Newtons Method for Non Linear System

(4) **Interpolation** (7 Lecture)
   (a) Introduction to Interpolation
   (b) Lagrange Approximation (Lagranges Interpolating Formulas)
   (c) Newton Polynomials (Divided difference, Forward and Backward Interpolations)

(5) **Curve Fitting** (7 Lecture)
   (a) Least Squares Line and its related problems
   (b) Curve Fitting Non Linear Least Squares
   (c) Interpolation by Spline Functions

(6) **Numerical Differentiation and Integration** (6 Lecture)
   (a) Approximating the derivative Numerical Differentiation Formulas (Central, Forward and Backward Formulas)
   (b) Introduction to Quadrature Formulas
   (c) Analysis of Trapezoidal and Simpsons Rule

(7) **Numerical Optimization** (2 Lecture)
   (a) Minimization of a function (Nelder- Mead Method)

(8) **Solution to Differential Equations** (7 Lecture)
   (a) Introduction to Differential Equations (Interpretation of Point wise Solutions)
   (b) Eulers Method and its analysis
   (c) Heuns Method (Modified Eulers Method)
   (d) Taylor Series Method
   (e) Runge Kutta Methods (of Orders 2 and 4)

Reference Books

(a) John Mathews and Kurtis Fink : Numerical Methods using Matlab (Prentice Hall)
(b) K.E Atkinson : Numerical Analysis
(c) S.S Sastry : Numerical Analysis

MTS4204 C++

(1) **Introduction** (5 Lecture)
- (a) Concept, Benefits and Application of OOP
- (b) Structure of C++ Programming
- (c) Tokens, expressions and control structures, keywords, Identifiers, data types operators in C++.

(2) **Functions in C++** (7 Lectures)
- (a) Function Prototyping
- (b) Call by value, Call by reference
- (c) Return by reference
- (d) Inline Functions
- (e) Default arguments
- (f) Function overloading
- (g) Friend and Virtual functions

(3) **Class and Objects** (10 Lectures)
- (a) Introduction to classes and creating objects
- (b) Friend classes
- (c) Static class members
- (d) Nested classes
- (e) Local classes
- (f) Memory allocation for objects
- (g) Array to objects
- (h) Objects as function arguments
- (i) Constructors and destructors

(4) **Inheritance, Pointers, Virtual functions and Polymorphism** (7 Lectures)
- (a) Single, Multilevel, Multiple, Hierarchical and Hybrid Inheritance
- (b) Virtual base classes
- (c) Abstract classes
- (d) Pointer to objects, pointer to derived class
- (e) Operator overloading

(5) **Control Structures** (5 Lectures)
- (a) Decision making structures: If, if-else, switch
- (b) Loop Control structures: While, do-while, for
- (c) Nested structures
- (d) break and continue

(6) **I/O System Basics** (6 Lectures)
- (a) C++ streams, C++ stream classes
- (b) Formatted I/O, Unformatted I/O operations
- (c) Overloading ¡¡and ¿¿, creating own insertions
- (d) Extractor and manipulator functions

(7) **File I/O and Array Based I/O** (6 Lectures)
- (a) Classes for file stream operations
- (b) Opening and closing of file, detecting EOF
- (c) Random access, I/O status
- (d) Array based class, Array based I/O stream, random access within the array
- (e) Dynamic arrays
- (f) Custom extractors and inserters

(8) **Templates and Exception handling** (7 Lectures)
- (a) Generic functions
- (b) Templates, class Templates, functions Templates
- (c) Member function templates, template arguments
- (d) Exception handling function templates, template arguments

(e) Exception handling fundamentals, exception handling options
(f) Catching all exceptions, restricting exceptions and rethrowing Exceptions.

Reference Books

(a) E. BALAGURUSWAMY: Object Oriented Programming with C++ .
(b) HERBERT SCHILDT : C++ the Complete Reference
(c) B. CHANDRA : A Treatise on Object Oriented Programing. Using C++
(d) NELSON : Serial communication - A C++ developers guide

MTS4205 Data Structures Using C

(1) **Introduction** (2 Lectures)
- (a) Data, Data Types .Abstract Data Types, Data Structures, Linear and Non-Linear Data Structures
- (b) Algorithm Analysis

(2) **Arrays** (4 Lectures)
- (a) Arrays as ADT, 1-D,2-D,Multidimensional arrays
- (b) Applications
- (c) Polynomial Representation in one variable (using array of structures)

(3) **Stacks** (5 Lectures)
- (a) ADT, Push and POP operations
- (b) Stack implementation using array
- (c) Stack Applications
  - (i) Infix to postfix conversion of expression
  - (ii) Postfix expression Evaluation
  - (iii) Recursion

(4) **Queues** (8 Lectures)
- (a) ADT, Insert and Delete Operations
- (b) Queue implementation using arrays
- (c) Queue Types
  - (i) Priority Queue
  - (ii) Circular Queue
  - (iii) Dequeue
- (d) Queue Applications
- (e) FCFS CPU scheduling Algorithm
- (f) Round Robin CPU scheduling Algorithm

(5) **Linked List** (8 Lectures)
- (a) Concept, Operations Insert, Delete, Traversal,
- (b) Static implementation using arrays, Dynamic implementation
- (c) Doubly linked list
- (d) Circular Linked list
  - (i) Singly
  - (ii) Doubly
- (e) Linked List Applications
  - (i) Stack using linked list
  - (ii) Queue using Linked List
- (f) Merging of two linked list

(6) **Trees** (8 Lectures)
- (a) Terminology and Concept
- (b) Binary Tree Representation
  - (i) Static implementation using arrays
  - (ii) Linked representation
- (c) Binary search tree
  - Operations on BST
- (d) Tree Traversals
- (e) representing general trees as binary trees

(7) **Searching and Sorting** (8 Lectures)
- (a) Searching
  - (i) concept and need
  - (ii) Techniques,Linear search, Binary search,Indexed sequential Search
- (b) Sorting
  - (i) Concept and need
  - (ii) Techniques

(A) Comparison Based (Bubble,quick,Insertion,Merge)
(B) Linear order sorting (Counting)

(8) **Graphs** (5 Lectures)

(a) Terminology and Concept
(b) Graph Representations
  (i) Adjacency Matrix
  (ii) Adjacency List
  (iii) Adjacency Multilist
(c) Traversals
  (i) DFS
  (ii) BFS

Reference Books

(a) Tanenbaum, Langsam, Augenstein : Data structures using C,PHI1994
(b) D. Samantha : Classic Data Structures,PHI2002

MTS4206 Practical - III

Practical - III : Based on Data Structures using C and C++

MTS4207 Practical - IV

Practical - IV : Mini project based on C-Programming and Database Management systems.