# M.Sc. Applied Mathematics

## Semester - I

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## Semester - II

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## Semester - III

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### SEMESTER – IV

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**Total Credits: 80**

### ELECTIVES FOR M.SC. APPLIED MATHEMATICS

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UNIT I  PARTIAL DIFFERENTIATION  9  

UNIT II  IMPLICIT FUNCTIONS AND INVERSE FUNCTIONS  9  

UNIT III  TAYLOR’S THEOREM AND APPLICATIONS  9  
Taylor’s theorem for functions of two variables – Maxima and Minima of functions of two and three variables – Lagrange Multipliers.

UNIT IV  LINE AND SURFACE INTEGRALS  9  
Definition of line integrals – Green’s theorem – Applications – Surface integrals – Gauss theorem – Verification of Green’s and Gauss theorems.

UNIT V  TRANSFORMATION AND LINE INTEGRALS IN SPACE  9  
Change of variables in multiple integrals – Definition of line integrals in space – Stoke’s theorem - Verification of Stoke’s theorem.

TOTAL : 45 PERIODS

BOOK FOR STUDY:  
1. Widder D.V., “Advanced Calculus”, Prentice Hall of India, New Delhi, 12th Print, 2nd Edition,2002. (Unit 1: Chapter 1: Sections 3,4,8 and 11, Unit 2: Chapter 1: Sections 5,6,7,10 and 12, Unit 3: Chapter 1: Section 9 and Chapter 4: Sections 1-5, Unit 4: Chapter 7: Sections 1-4, Unit 5: Chapter 7: Sections 5 and 6 (except 6.5)).

REFERENCES:  

UNIT I  GROUPS AND SYMMETRY  10  
UNIT II  MORE GROUP THEORY  9
The operations of a Group on itself - The Class Equation of the Icosahedral Group -
Operations on Subsets - The Sylow theorems - The Group of Order - Computation in
the Symmetric Group - The Free Group.

UNIT III  RINGS  8
Definition of a Ring - Formal Construction of Integers and Polynomials -
Homomorphism and Ideals - Quotient Rings and Relations in a Ring - Adjunction of
Elements - Integral Domains and Fraction Fields - Maximal Ideals.

UNIT IV  FACTORIZATION  9
Factorization of Integers and Polynomials - Unique Factorization Domains, Principal
Ideal Domains, and Euclidean Domains - Gauss’s Lemma - Explicit Factorization of
Polynomials - Primes in the Ring of Gauss Integers - Algebraic Integers.

UNIT V  FIELDS  9
Examples of fields - Algebraic and Transcendental Elements - The Degree of a Field
Extension - constructions with Ruler and Compass - Symbolic Adjunction of Roots -
Finite Fields - Function Fields - Transcendental Extensions.

TOTAL : 45 PERIODS

BOOK FOR STUDY:
and 10 Chapter 5, Chapter6 first 7 sections, Chapter 10 first 7 sections, Chapter
11 first 6 and Chapter 13)

REFERENCES:
1980.

AM 9313  ORDINARY DIFFERENTIAL EQUATIONS  L T P C
3 0 0 3

UNIT I  LINEAR EQUATIONS  9
Higher order equations – Linear independence – Wronskian – Variation of
parameters – Systems of Linear differential equations - Existence and uniqueness
theorem.

UNIT II  EXISTENCE THEOREM AND BOUNDARY VALUE PROBLEMS  9
Successive approximations - Picard’s theorem – Boundary Value problems – Sturm–
Liouville problem - Green’s Functions.

UNIT III  STABILITY  9
Autonomous systems – The phase plane – Critical points and stability for linear
systems – Stability by Liapunov’s direct method – Simple critical points of non-linear
systems.

UNIT IV  LEGENDRE EQUATION  9
Power series solutions – Second order linear equations with ordinary points –
Legendre equation – Legendre polynomials – Rodrigue’s formula – Recurrence
relations – Orthogonality.
UNIT V  BESSEL EQUATION  9
Second order equations with regular singular points – Series solution – Bessel
Equation – Bessel functions of first kind – Recurrence relations – Orthogonality.

TOTAL : 45 PERIODS

TEXT BOOKS:
1. Deo S.G., Lakshmikantham V. and Raghavendra V. “Text Book of Ordinary
   2000. Sections: 2.1 to 2.8, 4.1, 4.2, 4.4, 5.1 to 5.5, 7.1 to 7.3, 3.2 to 3.4.
2. Simmons G.F. and Krantz S. G., “Differential Equations, Theory, Technique and
   Sections: 2.3, 3.3, 3.5, 4.1 to 4.5, 6.5, 10.1 to 10.4, 11.1 to 11.6.

REFERENCES:
2. Elsgolts, “Differential equation and the calculus of variations”, MIR Publications,
   1980.

AM 9314  CLASSICAL MECHANICS

UNIT I  KINEMATICS  9
Kinematics of a particle and a rigid body – Moments and products of inertia
Kinetic energy – Angular momentum.

UNIT II  METHODS OF DYNAMICS IN SPACE  9
Motion of a particle – Motion of a system – Motion of a rigid body.

UNIT III  APPLICATIONS OF DYNAMICS IN SPACE  9
Motion of a rigid body with a fixed point under no forces – Spinning top – General
motion of top.

UNIT IV  EQUATIONS OF LAGRANGE AND HAMILTON  9
Lagrange’s equation for a particle – Simple dynamical system – Hamilton’s
equations.

UNIT V  HAMILTONIAN METHODS  9
Natural Motions – Space of events – Action – Hamilton’s principle – Phase space –
Liouville’s theorem.

TOTAL: 45 PERIODS

BOOK FOR STUDY:
   Chapters 11,12,14,15,16. (excluding articles : 12.3,12.5,14.3,14.4, 15.2 & 16.2).
REFERENCES:

AM 9315
OBJECT ORIENTED PROGRAMMING
L T P C
3 0 0 3

UNIT I
FUNCTIONS AND CLASSES IN C++

UNIT II
INHERITANCE AND POLYMORPHISM IN C++
Single inheritance – Multiple inheritance – Hierarchical inheritance – Hybrid inheritance – Abstract base class – Virtual functions – Dynamic binding – Polymorphism – Virtual base classes

UNIT III
INPUT/OUTPUT IN C++
Input/Output operations – Overloading the insertion and extraction operators – I/O stream classes – File Input/Output – Exception handling

UNIT IV
JAVA FUNDAMENTALS
Features of Java – Classes – Inheritance – Packages - Interfaces – Exception handling.

UNIT V
JAVA PROGRAMMING

TOTAL : 45 PERIODS

BOOKS FOR STUDY:
REFERENCES:

AM 9316 REAL ANALYSIS

UNIT I RIEMANN-STIELTGES INTEGRAL 9
Definition and existence of the integral, Properties of the integral, Integration and Differentiation. The Four Derivatives-Continuous non differentiable functions-Functions of Bounded Variation

UNIT II SEQUENCES AND SERIES OF FUNCTIONS 9
Pointwise convergence, Uniform convergence, Uniform convergence and continuity, Uniform convergence and Integration, Uniform Convergence and differentiation. Equi-continuous families of functions, Stone-Weierstrass theorem

UNIT III MEASURE AND MEASURABLE SETS 9
Lebesgue Outer Measure-Measurable Sets-Regularity-Measurable Functions-Borel and Lebesgue Measurability-Abstract Measure-Outer Measure-Extension of a Measure –Completion of a Measure.

UNIT IV LEBESGUE INTEGRAL 9
Integrals of simple functions-Integrals of Non Negative Functions-The General Integral-Integration of Series-Riemann and Lebesgue Integrals-Legesgue Differentiation Theorem- Integration and Differentiation-The Lebesgue Set-Integration with respect to a general measure

UNIT V LEBESGUE DECOMPOSITION AND PRODUCT MEASURE 9
Convergence in Measure-Almost Uniform convergence-Signed measures and Hahn Decomposition - Radon-Nikodym Theorem and its applications-Measurability in a product space- The Product measure and Fubini’s Theorem.

BOOKS FOR STUDY:
REFERENCES:

AM 9317 OBJECT ORIENTED PROGRAMMING LABORATORY

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1. Function Overloading (both in C++ and Java)
2. Function Templates and Class Templates in C++
3. Classes in C++ with all possible operations/operators for encapsulating Complex Number, String, Time, Date and Matrix (Operators are to be overloaded)
4. Employee class with derived classes for specialized employees (Both in C++ and Java)
5. Interfaces and Packages in Java
6. Polymorphism (both in C++ and Java)
7. Multithreading in Java
8. Applet in Java
9. Window using AWT in Java

TOTAL : 60 PERIODS

AM 9321 LINEAR ALGEBRA

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UNIT I VECTOR SPACES AND LINEAR MAPS

UNIT II DIAGONALIZATION AND THE PRIMARY DECOMPOSITION THEOREM
Eigen spaces-Algebraic and Geometric multiplicities – Cayley-Hamilton theorem

UNIT III UNITARY TRANSFORMATIONS
Unitary matrices and their properties-rotation matrices-Schur, Diagonal and Hessenberg forms and Schur Decomposition.

UNIT IV THE JORDAN CANONICAL FORM
Similarity Transformations and change of basis-Generalised eigen vectors-Canonical basis-Jordan canonical form – Applications to linear differential equations – Diagonal and the general cases.
UNIT V  APPLICATIONS


TOTA L : 45 PERIODS

BOOKS FOR STUDY:

REFERENCES:

AM 9322  PROBABILITY AND RANDOM PROCESSES  L  T  P  C
3  1  0  4

UNIT I  PROBABILITY AND RANDOM VARIABLES  9


UNIT II  TWO DIMENSIONAL RANDOM VARIABLES  9

Joint distributions – Transformation of random variables and their distributions – Conditional expectation – Computing probabilities and expectations by conditioning – Correlation and Regression.

UNIT III  LIMIT THEOREMS  9

Modes of convergence – Markov, Chebyshev’s and Jensen’s inequalities – Weak law of large numbers – Strong law of large numbers – Kolmogorov’s inequality - Central limit theorem (iid case).

UNIT IV  MARKOV CHAINS  9


UNIT V  MARKOV PROCESSES  9


L: 45 T: 15
BOOKS FOR STUDY:

REFERENCES:

AM 9323 COMPLEX ANALYSIS

UNIT I COMPLEX INTEGRATION

UNIT II CALCULUS OF RESIDUES
Homology – Homologous form of Cauchy’s theorem – Calculus of Residues – Contour integration through residues.

UNIT III DOMAIN CHANGING MAPPINGS
Conformality – Normal family – Riemann mapping theorem

UNIT IV HARMONIC FUNCTIONS
Properties – The mean-value property - Poisson’s Formula - Schwarz’s theorem – Harnack’s principle

UNIT V MEROMORPHIC AND ENTIRE FUNCTIONS
Meromorphic functions – Mittag Leffler’s theorem – Infinite partial fraction of \( \frac{\cot(\pi z)}{z} \) - Infinite product – Canonical Product – Gamma Functions – Jensen’s formula- Order and Genus of an Entire function - Hadamard’s theorem – Riemann Zeta function

BOOK FOR STUDY:

REFERENCES:
UNIT I  FIRST ORDER EQUATIONS
Integral surfaces passing through a given curve – Surfaces orthogonal to a given system of surfaces – Compatible system of equations – Charpit’s method.

UNIT II  SECOND ORDER EQUATIONS
Classification of second order Partial Differential Equations – Reduction to canonical form – Adjoint operators – Riemann’s method.

UNIT III  HYPERBOLIC EQUATIONS

UNIT IV  PARABOLIC EQUATIONS
Diffusion equation – Solution of Diffusion equation in cylindrical and spherical polar coordinates by method of Separation of variables – Solution of Diffusion equation by Fourier transform.

UNIT V  ELLIPTIC EQUATIONS

BOOK FOR STUDY:

REFERENCES:

UNIT I  TOPOLOGICAL SPACES
Topological spaces – Basis for a topology – Product topology on finite cartesian products – Subspace topology.
UNIT II CLOSED SETS AND CONTINUOUS FUNCTIONS
9

UNIT III CONNECTEDNESS AND COMPACTNESS
9
Connected spaces – Components – Path components – Compact spaces – Limit point compactness – Local compactness.

UNIT IV COUNTABILITY AND SEPARATION AXIOMS
9

UNIT V URYSOHN LEMMA AND TYCHONOFF THEOREM
9

TOTAL: 45 PERIODS

BOOK FOR STUDY:
   Chapter 2, sections 12, 13, 15, 16, 17, 18, 20, 21 Chapter 3 sections 23, 25, 26, 28, 29, Chapter 4, sections 30, 31, 32, 33, 34, 35, 37.

REFERENCES:

AM 9331 FUNCTIONAL ANALYSIS
L T P C
3 0 0 3

UNIT I BANACH SPACES
7
Banach Spaces - Continuous linear transformations.

UNIT II FUNDAMENTAL THEOREMS IN NORMED LINEAR SPACES
9

UNIT III HILBERT SPACES
10

UNIT IV OPERATOR ON A HILBERT SPACE
9
The adjoint of an operator – Self-adjoint operators – Normal and unitary operators – Projections.
UNIT V  SPECTRAL AND FIXED POINT THEORIES
Matrices – Determinants and the spectrum of an operator – spectral theorem – Fixed point theorems and some applications to analysis.

TOTAL : 45 PERIODS

BOOK FOR STUDY:

REFERENCES:

AM 9332  NUMERICAL ANALYSIS  L T P C
3 0 0 3

UNIT I  SYSTEMS OF LINEAR EQUATIONS AND ALGEBRAIC EIGENVALUE PROBLEMS  9

UNIT II  INTERPOLATION, DIFFERENTIATION AND INTEGRATION  9

UNIT III  APPROXIMATION OF FUNCTIONS  9
Norms of functions – Best Approximations: Least squares polynomial approximation – Approximation with Chebyshev polynomials – Piecewise Linear & Cubic Spline approximation.

UNIT IV  ORDINARY DIFFERENTIAL EQUATIONS  9
UNIT V  PARTIAL DIFFERENTIAL EQUATIONS  9
Elliptic equations: Five point finite difference formula in rectangular region – truncation error; One-dimensional Parabolic equation: Explicit and Crank-Nicholson schemes; Stability of the above schemes - One-dimensional Hyperbolic equation: Explicit scheme;
TOTAL : 45 PERIODS

BOOKS FOR STUDY:

REFERENCES:

AM 9333  MATHEMATICAL PROGRAMMING  L T P C
3 0 0 3

UNIT I  LINEAR PROGRAMMING  9
Formulation and Graphical solutions – Simplex method – Transportation and Assignment problems.

UNIT II  ADVANCED LINEAR PROGRAMMING  9

UNIT III  INTEGER PROGRAMMING  9
Cutting plane algorithm – Branch and bound technique – Applications of Integer programming.

UNIT IV  NON-LINEAR PROGRAMMING  9
Classical optimization theory : Unconstrained problems – Constrained problems – Quadratic programming.

UNIT V  DYNAMIC PROGRAMMING  9
Principle of optimality – Forward and backward recursive equations – Deterministic dynamic programming applications.
TOTAL: 45 PERIODS
BOOKS FOR STUDY:

REFERENCES:

AM 9334 CONTINUUM MECHANICS

UNIT I TENSORS: 9

UNIT II KINEMATICS OF A CONTINUUM: 9
Material and Spatial descriptions – Material derivative – Deformation – Principal Strain – Rate of deformation – Conservation of mass – Compatibility conditions.

UNIT III STRESS 9
Stress vector and tensor – Components of a stress tensor – Symmetry – Principal Stresses – Equations of motion – Boundary conditions.

UNIT IV LINEAR ELASTIC SOLID 9
Isotropic solid – Equations of infinitesimal theory – Examples of elastodynamics

UNIT V NEWTONIAN VISCOUS FLUID 9
Equations of hydrostatics – Newtonian fluid – Boundary conditions – Stream lines
Examples of laminar flows – Vorticity vector – Irrotational flow.

TOTAL : 45 PERIODS

BOOK FOR STUDY:
REFERENCES:

AM 9335 INTEGRAL EQUATIONS AND CALCULUS OF VARIATIONS

UNIT I VARIATIONAL PROBLEMS
Variation of a functional and its properties – Euler’s equations – Functionals with several arguments, higher order derivatives – Functionals dependent on functions of several independent variables – Variational Problems in Parametric form.

UNIT II VARIATIONAL PROBLEMS WITH MOVING BOUNDARIES AND WITH SUBSIDIARY CONDITIONS
Variation problems with a movable boundary for functionals dependent on one and two functions - One-sided variations – Constraints – Isoperimetric Problems - Applications.

UNIT III INTEGRAL EQUATIONS WITH SEPARATE KERNELS AND NEUMANN SERIES
Integral equations with degenerate kernels – Solution by reduction to algebraic equations – Fredholm Alternative – Method of successive approximaion for equation of second kind – Neumann series and Resolvent kernel - Fredholm Theorems (without proof) - Applications.

UNIT IV EQUATIONS WITH SYMMETRIC KERNELS

UNIT V APPROXIMATE METHODS

BOOKS FOR STUDY:

REFERENCES:
Introduction to MATLAB Fundamentals


Lab Exercises on Numerical Methods:

- **Numerical Linear Systems**
  - Gaussian Elimination method with pivoting
  - Gauss-Seidal iterative methods, Power methods

- **Interpolation, Approximations and Quadratures**
  - Newton divided-difference and finite difference Interpolation,
  - Composite Simpson and Composite Gaussian quadratures
  - Cubic Spline Approximation

- **Numerical methods for ordinary Differential Equations**
  - Euler’s method. Fourth order Runge-Kutta Method, Adams-Bashforth
  - Multi-Step method

- **Finite Difference Methods for BVP s**
  - Two-Point BVP, Elliptic Equations, Parabolic Equations, Hyperbolic Equations.

Introduction to TORA Package

Lab exercises on Mathematical Programming:

- **Linear Programming Models**
  - Simplex Method, Big M method – Bounded Variables method

- **Integer Programming Models**
  - Cutting plane method, Branch and Bound method

Network Problems

REFERENCES:


UNIT I

UNIT II  HYPERCONVEX SPACES AND NORMAL STRUCTURES IN METRIC SPACES  10


UNIT III  CONTINUOUS MAPPING IN BANACH SPACES  10


UNIT IV  METRIC FIXED POINT THEORY  8

Contraction mappings – Basic theorem for nonexpansive mapping – Structure of the fixed point set - Asymptotically regular mapping – Set valued mappings.

UNIT V  BANACH SPACE ULTRAPowers  8

Some fixed point theorem – Asymptotically nonexpansive mappings – The demiclosedness principle.

TOTAL : 45 PERIODS

BOOK FOR STUDY:

REFERENCES:

AM 9002  DISCRETE MATHEMATICS  L T P C
3 0 0 3

UNIT I  LOGIC  9

UNIT II  NUMBER THEORY  9
The Integers and Division – Integers and Algorithms – Applications of Number Theory.

UNIT III  COUNTING  9
UNIT IV  RECURRENCE RELATIONS  9

UNIT V  BOOLEAN ALGEBRA  9

TOTAL: 45 PERIODS

BOOK FOR STUDY:
   [Sections: 1.1 to 1.5, 3.3; 2.4 to 2.6; Chapter 4 and 6.5, 6.6; 6.1 to 6.4; Chapter 10]

REFERENCES:

AM 9003  NUMBER THEORY  L T P C
3 0 0 3

UNIT I  DIVISIBILITY  9

UNIT II  CONGRUENCES  9

UNIT III  APPLICATION OF CONGRUENCE AND QUADRATIC RECIPROCITY  9
Public – Key cryptography – Prime power moduli – Prime modulus - Primitive roots and power residues – Quadratic residues – The Gaussian reciprocity law.

UNIT IV  FUNCTIONS OF NUMBER THEORY  9
Greatest integer function – Arithmetic functions – Mobius inversion formula – Recurrence functions – Combinational number theory

UNIT V  DIOPHAUTIN EQUATIONS AND FAREY FRACTIONS  9
The equations ax + by = c Pythagorean triangle – Shortest examples – Farey sequences – Rational approximations.

TOTAL: 45 PERIODS

BOOK FOR STUDY:
   Sections 1.1, 1.2, 1.3, through theorem 1.18, 1.4 through theorem1.21; 2.1, 2.2, 2.3, 2.4 thorough example 9; 2.5, 2.6 through example12, 27through theorem 2.29, 2.8 2.5 through corollary 2.38, 3.1, 2.3; 4.1, 4.5; 5.1, 5.3, 5.4, 6.1, 6.2
REFERENCES:

AM 9004 MATHEMATICAL STATISTICS

UNIT I SAMPLING DISTRIBUTIONS AND ESTIMATION THEORY 9
Sampling distributions – Characteristics of good estimators – Method of Moments – Maximum Likelihood Estimation – Interval estimates for mean, variance and proportions.

UNIT II TESTING OF HYPOTHESIS 9
Type I and Type II errors - Tests based on Normal, t, $\chi^2$ and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit.

UNIT III CORRELATION AND REGRESSION 9
Method of Least Squares - Linear Regression – Normal Regression Analysis – Normal Correlation Analysis – Partial and Multiple Correlation - Multiple Linear Regression.

UNIT IV DESIGN OF EXPERIMENTS 9
Analysis of Variance – One-way and two-way Classifications – Completely Randomized Design – Randomized Block Design – Latin Square Design.

UNIT V MULTIVARIATE ANALYSIS 9
Covariance matrix – Correlation Matrix – Normal density function –Principal components – Sample variation by principal components – Principal components by graphing.

TOTAL: 45 PERIODS

BOOKS FOR STUDY:

REFERENCE:
UNIT I  MARKOV AND STATIONARY PROCESSES 9

UNIT II  RENEWAL PROCESSES 9

UNIT III  MARKOV RENEWAL AND SEMI–MARKOV PROCESSES 8
Definition and preliminary results – Markov renewal equation – Limiting behaviour - First passage time.

UNIT IV  BRANCHING PROCESSES 10
Generating functions of branching processes – Probability of extinction – Distribution of total number of progeny – Generalization of classical Galton – Watson process – Continuous time Markov branching process – Age dependent branching process – Bellman - Harris process

UNIT V  MARKOV PROCESSES WITH CONTINUOUS STATE SPACE 9

TOTAL: 45 PERIODS

BOOK FOR STUDY:

REFERENCES:
UNIT II  CONTEXT FREE LANGUAGES  9
Grammar – Context Free Grammars – Derivation trees – Simplification of context –
Free grammar (only Construction and no proof of equivalence of grammars) –
Chomsky normal Form – Greibach Normal Form.

UNIT III  PUSH DOWN AUTOMATA AND PROPERTIES AND CONTEXT
FREE LANGUAGES  9
Pushdown automata – Push down automata and Context free languages – Pumping
lemma for context free languages.

UNIT IV  TURING MACHINE AND UNDECIDABILITY  9
Turing Machine model – Computational languages and functions – Modifications of
Turing machines (only description, no proof for theorems on equivalence of the
modification) – Problems – Properties of recursive and recursively enumerable
languages – Universal Turing Machine and the undecidable problem.

UNIT V  THE CHOMSKY HIERARCHY  9
Regular grammar – Unrestricted grammar – Context Sensitive languages – Linear
bounded automata – Relation between classes of languages.

TOTAL: 45 PERIODS

BOOK FOR STUDY:
1. Hopcroft J.E. and Ullman J.D. “Introduction to Automata, Languages and
   Computation”, Narosa Publishing House, 1987
   (Sections 2.1 to 2.5, 3.1, 4.1 to 4.6, 5.1 to 5.3, 6.1, 7.1 to 7.5, 8.1 to 8.3, 9.1 to
   9.4)

REFERENCES:
1. Hopcroft, J.E., Rajeev Motwani and Ullman, J.D. “Introduction to Automata
3. Peter Linz, “An Introduction to Formal Languages and Automata”, Narosa

AM 9007  DATA STRUCTURES

UNIT I  STACKS AND RECURSION  9
Arrays, Structures and Stacks in C – Recursion in C.

UNIT II  QUEUES AND LISTS  9
Queue and its sequential representation, Linked lists, Lists in C, Circular linked lists.

UNIT III  TREES  9
Binary Trees – Binary tree representation – Lists as binary trees – Application of
trees.

UNIT IV  SORTING  9
General background – Exchange sorts – Selection and Tree sorting – Insertion sorts
– Merge and Radix sorts.
UNIT V  SEARCHING
Basic search Technique – Tree searching – Hashing.

BOOK FOR STUDY:
   (Chapter 1: Sections 1.2-1.4, Chapter 2, Chapter 3: Sections 3.1 to 3.3, Chapter 4: Sections 4.1-4.3 and 4.5, Chapter 5: Sections 5.1, 5.2 and 5.5, Chapter 6, Chapter 7: Sections 7.1, 7.2 and 7.4).

REFERENCE:

AM 9008      FUZZY SET THEORY    L  T  P  C
UNIT I  BASICS                        3  0  0  3
Fuzzy sets-Basic types – Fuzzy sets – Basic concepts – Additional properties of $\alpha$-cuts – Representations of fuzzy sets – Extension principle for fuzzy sets.

UNIT II  OPERATIONS ON FUZZY SETS    9

UNIT III  FUZZY ARITHMETIC          9
Fuzzy numbers – Linguistic variables – Arithmetic operations on Intervals – Arithmetic operations on fuzzy numbers.

UNIT IV  FUZZY RELATIONS           9
Crisp and fuzzy relations – Binary fuzzy relations – Binary relations on a single set – Fuzzy equivalence relations – Fuzzy compatibility relations – Fuzzy ordering relations.

UNIT V  FUZZY RELATION EQUATIONS   9
Partition – Solution method – Fuzzy relation equations based on sup-i compositions and inf-w compositions.

TOTAL: 45 PERIODS

BOOK FOR STUDY:
   (Sections 1.3, 1.4, 2.1, 2.2, 2.3, Sections 3.1 to 3.5, Sections 4.1 to 4.4 and Sections 5.1, 5.3 to 5.7 and Sections 6.2 to 6.5).

REFERENCES:
UNIT I  INTRODUCTION  

UNIT II  CONNECTIVITY AND TRAVERSIBILITY  
Connectivity – Whitney’s theorems – Blocks – Applications of connectivity – Euler’s tour – Hamilton Cycles – The Chinese Postman Problem – The traveling Salesman Problem (only a brief introduction on these problems.)

UNIT III  MATCHING  
Matching and covering bipartite graphs – perfect matchings – Independent sets.

UNIT IV  COLORING  
Vertex chromatic number – k-critical graphs – Brook’s theorem – Chromatic polynomials – Girth and Chromatic number.

UNIT V  PLANAR GRAPHS  
Planar graphs – Euler’s formula – Kuratowski’s theorem – Five color theorem.

TOTAL: 45 PERIODS

BOOK FOR STUDY:

REFERENCES:

UNIT I  INTEGRAL FORMULATIONS AND VARIATIONAL METHODS  

UNIT II  FINITE ELEMENT ANALYSIS OF ONE - DIMENSIONAL PROBLEMS  
UNIT III EIGENVALUE AND TIME DEPENDENT PROBLEMS IN ONE DIMENSION
Formulation of eigenvalue problem – Finite element models – Applications of semi discrete finite element models for time-dependent problems – Applications to parabolic and hyperbolic equations.

UNIT IV FINITE ELEMENT ANALYSIS OF TWO-DIMENSIONAL PROBLEMS

UNIT V FINITE ELEMENT ERROR ANALYSIS
Various measures of errors – Convergence of solution – Accuracy of solution.

BOOK FOR STUDY:

REFERENCES:

AM 9011 DESIGN AND ANALYSIS OF ALGORITHMS L T P C
3 0 0 3

UNIT I ANALYZING ALGORITHMS

UNIT II SORTING

UNIT III GRAPH ALGORITHMS

UNIT IV STRING MATCHING

UNIT V POLYNOMIALS, MATRICES AND NP COMPLETENESS

TOTAL : 45 PERIODS
BOOK FOR STUDY:
   Chapters 2.3, 6.7, 23: Sections: 1.1, 4.1 to 4.3, 8.1, 22.1 to 23.3, 24.1, 24.3, 32.1, 32.3, 32.4, 30.1, 30.2, 34.1, to 34.3, 34.5.1, 34.5.4.

REFERENCES:

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AM 9012 NUMBER THEORY AND CRYPTOGRAPHY L T P C
3 0 0 3

UNIT I INTRODUCTION TO NUMBER THEORY
9
Time estimates for doing arithmetic - Divisibility and the Euclidean algorithm – Congruences - Modular exponentiation - Some applications to factoring

UNIT II QUADRATICS RESIDUES AND RECIPROCITY
9
Finite Fields - Multiplicative generators – Uniqueness of fields with prime power elements - Quadratic residues and reciprocity

UNIT III CRYPTOSYSTEMS
9

UNIT IV PRIMALITY AND FACTORING - I
9
Pseudoprimes - Strong pseudo primes - Solovay-Strassen Primality test – Miller - Rabin test - Rho method - Fermat factoring and factor bases - Quadratic sieve method

UNIT V PRIMALITY AND FACTORING - II
9
Elliptic Curves - Elliptic curve primality test - Elliptic Curve factoring - Pollard’s p - 1 method -Elliptic curve reduction modulo n - Lenstras Method.

TOTAL : 45 PERIODS

BOOK FOR STUDY:

REFERENCE:
UNIT I  VB.NET FUNDAMENTALS  9
Introduction to .NET Framework - Controls – Menus and Dialog Boxes – Variables and Operators – Decision Structures –Loops and Timers - Debugging -Trapping and Handling Errors

UNIT II  VB.NET PROGRAMMING  9

UNIT III  VB.NET UI DESIGN AND DATABASE APPLICATIONS  9

UNIT IV  VC++ FUNDAMENTALS  9

UNIT V  VC++ UI DESIGN AND DATABASE APPLICATIONS  9

BOOKS FOR STUDY:

REFERENCES:
UNIT II  PRESENT VALUE ANALYSIS AND ARBITRAGE  9

Interest rates – Present value analysis – Rate of return – Continuously varying interest rates – Pricing contracts via Arbitrage – An example in options pricing.

UNIT III  ARBITRAGE THEOREM AND BLACK-SCHOLES FORMULA  9


UNIT IV  EXPECTED UTILITY  9


UNIT V  EXOTIC OPTIONS  9


TOTAL: 45 PERIODS

BOOK FOR STUDY:

REFERENCES:

AM 9015  APPROXIMATION THEORY  

UNIT I  APPROXIMATION IN NORMED LINEAR SPACES  9


UNIT II  CHEBYSHEV POLYNOMIALS  9


UNIT III  INTERPOLATION  9

UNIT IV  BEST APPROXIMATION IN NORMED LINEAR SPACES  9
Introduction – Approximative properties of sets – Characterization and Duality.

UNIT V  PROJECTION  9
Continuity of metric projections – Convexity, Solarity and Cheyshevity of sets – Best simultaneous approximation.

TOTAL: 45 PERIODS

BOOK FOR STUDY:
1. Hrushikesh N. Mhaskar and Devidas V. Pai., “Fundamentals of approximation theory”, Narosa Publishing House, New Delhi, 2000, Chapter II (Except 2.6), IV (except 4.5, 4.6 & 4.7) and VIII (except 8.6 & 8.7).

REFERENCES:

FLUID MECHANICS

UNIT I  KINEMATICS OF FLUIDS IN MOTION  9

UNIT II  EQUATIONS OF MOTION OF A FLUID  9
Pressure at a point in a fluid – Boundary conditions of two inviscid immiscible fluids – Euler’s equations of motion – Bernoulli’s equation – Some potential theorems – Flows involving axial symmetry.

UNIT III  TWO DIMENSIONAL FLOWS  9
Two-Dimensional flows – Use of cylindrical polar co-ordinates – Stream function, complex potential for two-dimensional flows, irrotational, incompressible flow – Complex potential for standard two-dimensional flows – Two dimensional image systems – Milne-Thomson circle theorem – Theorem of Blasius.

UNIT IV  CONFORMAL TRANSFORMATION AND ITS APPLICATIONS  9
Use of conformal transformations – Hydrodynamical aspects of conformal mapping – Schwarz Christoffel transformation – Vortex rows.

UNIT V  VISCOUS FLOWS  9

TOTAL: 45 PERIODS
BOOK FOR STUDY:

REFERENCES:

AM 9017 
NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS 
L T P C
3 0 0 3

UNIT I 
NECESSARY BASICS

UNIT II 
ONE DIMENSIONAL PARABOLIC EQUATIONS
Explicit and Crank-Nicolson Schemes for $u_t = u_{xx}$ – Weighted average approximation - Derivative boundary conditions – Truncation errors – Consistency, Stability and convergence- Lax Equivalence theorem.

UNIT III 
MATRIX NORMS & TWO DIMENSIONAL PARABOLIC EQUATION

UNIT IV 
HYPERBOLIC EQUATIONS

UNIT V 
ELLIPTIC EQUATIONS
Solution of Laplace and Poisson equations in a rectangular region – Finite difference in Polar coordinate Formulas for derivatives near a curved boundary when using a square mesh – Discretisation error – Mixed Boundary value problems.

TOTAL: 45 PERIODS

BOOK FOR STUDY:

REFERENCES:
UNIT I  NETWORK MODELS
Scope and definition of network models - Minimal spanning tree algorithm - Shortest-route problem – Maximal-flow Model.

UNIT II  CPM AND PERT
Network representation – Critical path (CPM) computations – Construction of the time schedule – Linear programming formulation of CPM – PERT calculations.

UNIT III  GAME THEORY
Optimal solution of two-person zero-sum games – Mixed strategies – Graphical solution of (2 x n) and (m x 2) games – Solution of m x n games by linear programming.

UNIT IV  DECISION ANALYSIS
Decision making under certainty: analytic hierarchy process (AHP) – Decision making under risk – Decision under uncertainty.

UNIT V  MARKOVIAN DECISION PROCESS
Scope of the Markovian decision problem – Finite stage dynamic programming model – Infinite stage model – Linear programming solution.

TOTAL: 45 PERIODS

BOOK FOR STUDY:

REFERENCES:

UNIT I  THE BANACH FIXED POINT THEOREM AND ITERATIVE METHODS
The Banach fixed point theorem – The significance of Banach fixed point theorem – Applications to nonlinear equations – The Picard – Lindelof theorem – The Main theorem for iterative methods for linear operator equation – Applications to systems of linear equations and to linear integral equations.
UNIT II THE SCHAUDER FIXED POINT THEOREM AND COMPACTNESS 9

UNIT II FIXED POINTS OF MULTIVALUED MAPS 8
Generalized Banach fixed point theorem – Upper and lower semi continuity of multi-valued maps – Generalized Schauder fixed point theorem – Variational inequalities and Brouwer fixed point theorem.

UNIT III NONEXPANSIVE OPERATORS AND ITERATIVE METHODS 9

UNIT IV CONDENSING MAPS 10
A noncompactness measure – Condensing maps – Operators with closed range and an approximation technique for constructing fixed points – Sadovskii’s fixed point theorem for condensing maps – Fixed point theorem for perturbed operators – Application to differential equations in Banach spaces.

TOTAL: 45 PERIODS

BOOK FOR STUDY:

REFERENCES:
UNIT IV  GENERAL EXTREMAL PROBLEMS  9
Functionals of Linear Spaces - Representation of Linear Functionals - Extreme Points and Support Points- Properties of Extremal Functions - Extreme Points of $S$, Extreme Points of $\Sigma$.

UNIT V  COEFFICIENT CONJECTURE  9
Preliminaries – Proof of the Coefficient Conjecture

TOTAL : 45 PERIODS

BOOKS FOR STUDY:

REFERENCE:

AM 9021  WAVELET ANALYSIS  L T P C
3 0 0 3

UNIT I  FOURIER ANALYSIS  9
Fourier and inverse Fourier transforms – Continuous time convolution and the delta function – Fourier transform of square integrable functions – Poisson’s summation formula.

UNIT II  WAVELET TRANSFORMS AND TIME - FREQUENCY ANALYSIS  9

UNIT III  MULTI RESOLUTION ANALYSIS AND WAVELETS  11
The Haar wavelet construction – Multi resolution analysis – Riesz basis to orthonormal basis – Sealing function and scaling identity – Construction of wavelet basis.

UNIT IV  COMPACTLY SUPPORTED WAVELETS  10
Vanishing moments property – Meyer’s wavelets – Construction of a compactly supported wavelet – Smooth wavelets.

UNIT V  APPLICATIONS  6
Digital Filters – Discrete wavelet transforms and Multi resolution analysis – Filters for perfect reconstruction – Para unitary filters and orthonormal wavelets – Filter design for orthonormal wavelets – Biorthogonal filters.

TOTAL: 45 PERIODS

BOOKS FOR STUDY:
UNIT I  DERIVATION AND PROPERTIES OF NAVIER-STOKES EQUATIONS  

UNIT II  EXACT SOLUTIONS  
Exact solutions of the Navier-Stokes equations – Parallel flow – Other exact solutions.

UNIT III  BOUNDARY LAYER EQUATIONS AND THEIR PROPERTIES  
Derivation of boundary layer equations – Separation – Skin friction – Boundary layer along a flat plate – Similar solutions – Transformation of the boundary layer equations – Momentum and integral equations.

UNIT IV  EXACT AND APPROXIMATE METHODS  
Exact solutions of boundary layer equations – Flow past a wedge – Approximate methods – Application of the momentum equation – Von Karman and Pohlhausen method – Comparison – Methods of boundary layer control.

UNIT V  TURBULENT BOUNDARY LAYERS  
Turbulent flow – Introduction – Mean motion and fluctuations – Apparent stresses – Derivation of the stress tensor – Assumptions for turbulent flows – Prandtl’s mixing theory.

TOTAL: 45 PERIODS

BOOK FOR STUDY:
   Chapter 3(a,b,c,d,e,g), Chapter 4(a,c,d,e), Chapter 5 a(1,2,3,4,7), b(9,9a,10), Chapter 7(a,b,d,e), Chapter 8(b,c,d), Chapter 9(a), Chapter 10(a,b,c), Chapter 14 a(1,2,3,4,5,6), b(1,1.1,1.2), Chapter 18(a,b,c,d) and Chapter 19(a,b).

REFERENCES:

UNIT I  FLOW ALONG SURFACES AND IN CHANNELS  
Boundary layer and turbulence – Momentum equation – Laminar flow boundary layer equation – Plane plate in longitudinal flow – Pressure gradients along a surface – Exact solutions for a flat plate.

UNIT II  FORCED CONVECTION IN LAMINAR FLOW  
UNIT III FORCED CONVECTION IN TURBULENT FLOW


UNIT IV FREE CONVECTION

Laminar heat transfer on a vertical plate and horizontal tube – Turbulent heat transfer on a vertical plate – Free convection in a fluid enclosed between two plane walls – Mixed free and forced convection.

UNIT V MASS TRANSFER

Diffusion – Flat plate with heat and mass transfer – Integrated boundary layer equations of mass transfer – Similarity relations for mass transfer - Evaporation of water into air.

TOTAL: 45 PERIODS

BOOK FOR STUDY:

REFERENCES:

AM 9024 MATHEMATICAL ASPECTS OF FINITE ELEMENT METHOD L T P C
30 0 3

UNIT I BASIC CONCEPTS


UNIT II SOBOLEV SPACES

Review of Lebesgue integration theory, Weak derivatives, Sobolev norms and associated spaces, Inclusion relations and Sobolev’s inequality, Trace Theorems, Negative norms and duality.

UNIT III VARIATIONAL FORMULATIONS


UNIT IV CONSTRUCTION OF FINITE ELEMENT SPACE AND APPROXIMATION THEORY IN SOBOLEV SPACES

The Finite Element, Triangular finite elements, Lagrange element, Hermite element, Rectangular elements, Interpolant, Averaged Taylor polynomials, Error representation, Bounds for the Interpolation error, Inverse estimates
UNIT V  HIGHER DIMENSIONAL VARIATIONAL PROBLEMS

Variational formulation and approximation of Poisson’s and Neumann equations, Coercivity of the variational problem, Elliptic regularity estimates, Variational approximations of general Elliptic and Parabolic problems, Negative – Norm estimates.

TOTAL: 45 PERIODS

BOOKS FOR STUDY:

REFERENCES:

AM 9025  THEORY OF ELASTICITY  L  T  P  C
3  0  0  3

UNIT I  ANALYSIS OF STRAIN

Deformation, strain tensor in rectangular Cartesian coordinates, Geometric interpretation of infinitesimal strain, rotation, compatibility of strain components, properties of strain tensor, strain in spherical and cylindrical polar coordinates.

UNIT II  ANALYSIS OF STRESS

Stresses, laws of motion, Cauchy’s formula, equations of equilibrium, transformation of coordinates, Plane state of stresses, Cauchy’s stress quadric, shearing stress, Mohr’s circle, stress deviation, stress tensor in general coordinates, physical components of a stress tensor in general coordinates, equation of equilibrium in curvilinear coordinates.

UNIT III  LINEAR THEORY OF ELASTICITY

Generalized Hooke’s law, Stress-Strain relationship for an isotropic elastic material, Basic equation of elasticity for homogeneous isotropic bodies, boundary value problems, the problem of equilibrium and the uniqueness of solution of elasticity, Saint-Venant’s principle.

UNIT IV  TORSION

Torsion of prismatic bars, torsion of circular, elliptic and rectangular bars, membrane analogy, torsion of rectangular section and hollow thin walled sections.

UNIT V  SOLUTION OF TWO AND THREE DIMENSIONAL PROBLEMS IN ELASTICITY


TOTAL: 45 PERIODS
BOOKS FOR STUDY:

REFERENCES:

AM 9026 ALGORITHMIC GRAPH THEORY L T P C
3 0 0 3

UNIT I INTRODUCTION TO GRAPHS AND ALGORITHMIC COMPLEXITY  9

UNIT II PLANAR GRAPHS AND NETWORK FLOW  9

UNIT III GRAPH TRAVERSALS AND MATCHINGS 9

UNIT IV GRAPH COLOURING 9
Dominating sets, independence cliques – Coloring graphs – Edge – Coloring – Vertex – Coloring – Chromatic polynomials – Face coloring of embedded graphs – Five colour theorem – Four colour theorem.

UNIT V GRAPH PROBLEMS AND INTRACTABILITY 9
Introduction to NP - Completeness – Classes P and NP – NP - Completeness and Cook’s theorem. NP - Complete graph problems – Problems of vertex cover, independent set and clique – Problems of Hamiltonian paths and circuits and the traveling salesman problem – Problems concerning the coloring of graphs.

TOTAL : 45 PERIODS
BOOK FOR STUDY:

REFERENCE:

UNIT I  PERFECT GRAPHS
The Perfect graph theorem – Chordal graphs – Other class of Perfect graphs –
Imperfect Graphs – The Strong Perfect Graph Conjecture.

UNIT II  RAMSEY THEORY
Ramsey’s Theorem – Ramsey Numbers – Graph Ramsey Theory – Sperner’s
Lemma and Bandwidth.

UNIT III  EXTREMAL GRAPHS
Encodings of Graphs – Branchings and Gossip – List Coloring and Choosability –
Partitions Using Paths and Cycles.

UNIT IV  CONNECTEDNESS IN DIGRAPHS
Digraphs – Connected and Disconnected graphs – Strong digraphs – Digraphs and
matrices.

UNIT V  TOURNAMENTS
Properties of tournaments – Hamiltonian tournaments – Score Sequences.

TOTAL : 45 PERIODS

BOOKS FOR STUDY:

REFERENCES:
1. Martin Charles Golumbic, “Algorithmic Graph Theory and Perfect Graphs”,
UNIT I  MARKOVIAN QUEUES:  9
Arrival and Departure processes, single and multiple channel queues, Queues with
finite waiting room, Little’s formula, waiting time distributions, busy period analysis,
Erlang’s loss formula (Transient solutions for M/M/1 model) and Self-serving queues.

UNIT II  QUEUES WITH SPECIAL CHARACTERISTICS  9
Finite source queue, State-dependent queues, Balking and reneging, Bulk input and
bulk service models, Erlangian Models, Priority queues.

UNIT III  NON-MARKOVIAN QUEUES  9
M/G/1 queueing model, Pollaczek-Khintchine formula, steady-state system size
probabilities, waiting time distributions, Generalization of Little’s formula, Busy period
analysis.

UNIT IV  RELIABILITY CHARACTERISTICS  9
Reliability and hazard functions – exponential, normal, log-normal, weibull and
Gamma failure distributions – Time-dependent hazard models, Reliability of series,
stand by and parallel systems, k-out-of-m systems.

UNIT V  SYSTEM RELIABILITY  9
Redundancy techniques in system design, Optimal Design – Availability and
maintainability concepts, Markovian models for reliability and availability of repairable
two-unit systems, Preventive maintenance.

TOTAL: 45 PERIODS

BOOKS FOR STUDY:
   Sons, New York, 1998. (Chapters 1-5)
   Company Ltd., New Delhi, 1984. (Chapters 4-7)

REFERENCES:
   New Delhi, 1983.
   Hill, New Delhi, 2000.
3. A. Bivolioni, “Quality and Reliability of Technical Systems”, Spring, Belgin, 2nd
   Amsterdam, 2003.