BHARATHIAR UNIVERSITY, COIMBATORE.

M. Sc MATHEMATICS DEGREE COURSE WITH COMPULSORY DIPLOMA (AFFILIATED COLLEGES)

(Effective from the academic Year 2009-2010)

SCHEME OF EXAMINATIONS – CBCS PATTERN

Sem.	Study Components	Course title	Ins. hrs/ week	Examinations				Credit
				Dur.Hrs	CIA	Marks	Total Marks	
I	Paper 1	Algebra	7	3	25	75	100	5
	Paper 2	Real Analysis	7	3	25	75	100	5
	Paper 3	Ordinary DifferentialEquations	6	3	25	75	100	4
	Paper 4	Numerical Methods	6	3	25	75	100	4
	Elect.Dip. Paper I	Latex	4	3	25	75	100	3
II	Paper 5	Complex Analysis	6	3	25	75	100	5
	Paper 6	Partial Differential Equations	6	3	25	75	100	5
	Paper 7	Mechanics	6	3	25	75	100	4
	Paper 8	Operations Research	6	3	25	75	100	4
	Practical 1	Computer practical	2	3	40	60	100	3
	Elect.Dip. Paper II	Matlab	4	3	25	75	100	3
III	Paper 9	Topology	7	3	25	75	100	5
	Paper 10	Fluid Dynamics	7	3	25	75	100	5
	Paper 11	Mathematical Statistics	6	3	25	75	100	4
	Paper 12	Elective I	6	3	25	75	100	4
	Elect.Dip. Paper III	Mathematica	4	3	25	75	100	3
IV	Paper 13	Functional Analysis	7	3	25	75	100	5
	Paper 14	Mathematical Methods	7	3	25	75	100	5
	Paper 15	Computer Programming	6	3	25	75	100	4
	Practical 2	C++ Practical	2	3	40	60	100	3
	Paper 16	Elective II	6	3	25	75	100	4
	Elect.Dip. Paper IV	Practical	2	3	40	60	100	3
		Total					2200	90

LIST OF ELECTIVES

1.Number Theory
2.Graph Theory
3.Magnetohydro Dynamics
4.Control Theory
5.Differential Geometry
6.Fuzzy Logic and Fuzzy Sets
7.Cryptography
8. Neural Networks
9.Stochastic Differential Equations

List of Group Elective/Diploma papers (Colleges can choose any one of the Group/Diploma papers as electives)

	GROUP A Diploma in Mathematical Software	GROUP B Diploma in Mathematical Finance
Paper I/ Sem I	Latex	Probability Theory
Paper II/ Sem II	Matlab	Stochastic Processes
Paper III/ Sem III	Mathematica	Mathematical Finance I
Paper IV/ Sem IV	Practical	Mathematical Finance II

PAPER I – ALGEBRA

UNIT-I:

Group Theory:

Another counting principle – Sylow's theorem – Direct products

UNIT-II:

Ring Theory:

Euclidean rings – A particular Euclidean ring – Polynomial rings – Polynomials over the rational field.

UNIT-III:

Fields:

Extension Fields – Roots of polynomials – More about roots.

UNIT-IV:

Fields:

Elements of Galois theory – Finite Fields.

UNIT-V:

Linear Transformations:

Canonical forms: Triangular form – Trace and Transpose – Hermitian, unitary and normal Transformations.

Treatment as in:

Topics in Algebra by I.N.Herstein (II Edition)

UNIT I : Chapter 2 - Sections 2.11 to 2.13.
UNIT II : Chapter 3 - Sections 3.7 to 3.10.
UNIT III : Chapter 5 - Sections 5.1,5.3 and 5.5.
UNIT IV : Chapter 5 - Section 5.6.
Chapter 7 - Section 7.1.
UNIT V : Chapter 6 - Sections: 6.4,6.8 and 6.10.

References:

1. J.B.Fraleigh, A First Course in Abstract Algebra, Narosa Publishing House, New Delhi, 1988.
2.M.Artin, Algebra, Prentice-Hall, Englewood Cliff, 1991.

3. T.W.Hungerford, Algebra, Springer, New York, 1974.

PAPER II: REAL ANALYSIS

UNIT I:

RIEMANN STILTJES INTEGRAL:

Definition and Existence of the Integral – properties of the integral – Integration and differentiation – Integration of vector valued function – rectifiable curves.

UNIT II:

Uniform convergence and continuity – uniform convergence and integration - uniform convergence and differentiation – equicontinuous families of functions – The Stone Weirstrass theorem

UNIT III:

FUNCTIONS OF SEVERAL VARIABLES:

Linear transformation – contraction principle – Inverse function theorem – Implicit function theorem – determinants – derivatives of higher order – differentiation of integrals

UNIT IV:

LEBESGUE MEASURE:

Outer measure – Measurable sets and Lebesgue measure – Measurable functions – Littlewood's Theorem

UNIT V:

LEBESGUE INTEGRAL:

The Lebesgue integral of bounded functions over a set of finite measure – integral of a non – negative function – General Lebesgue Integral – convergence in measure

Treatment as in:
Principles of Mathematical Analysis by W. Rudin, McGraw Hill, New York, 1976.
Unit I – III: Chapters 6, 7, 9.

Treatment as in: Real Analysis by H.L. Roydon, Third Edition, Macmillan, New York, 1988.
Unit IV – V: Chapters 3 and 4.

References:

1. R.G.Bartle, Elements of Real Analysis, 2nd Edition, John Wily and Sons, New York, 1976.
2. W.Rudin, Real and Complex Analysis, 3rd Edition, McGraw-Hill, New York, 1986.

PAPER III: ORDINARY DIFFEENTIAL EQUATIONS

UNIT I:

Second order linear equations with ordinary points – Legendre equation and Legendre polynomials – Second order equations with regular singular points – Bessel equation.

UNIT II:

Systems of first order equations – existence and uniqueness theorem – Fundamental matrix.

UNIT III:

Non-homogeneous linear systems – linear systems with constant coefficients – linear systems with periodic co-efficients.

UNIT IV:

Successive approximation – Picard's theorem - Non-uniqueness of solution – Continuation and dependence on initial conditions, Existence of solutions in the large – Existence and uniqueness of solutions of systems.

UNIT V:

Fundamental results – Sturm's comparison theorem – Elementary linear oscillations. Comparison theorem of Hille-Winter – oscillations of $x'' + a(t)x = 0$ - Elementary non-linear oscillation.

Treatment as in:

1. Ordinary Differential Equations and Stability Theory by S.G.Deo and V.Raghavendra.

Unit I	-	Chapter – 3	-	Section 3.2 – 3.5
Unit II	-	Chapter – 4	-	Section 4.2 – 4.4
Unit III	-	Chapter – 4	-	Section 4.5 – 4.7
Unit IV	-	Chapter – 5	-	Section 5.3 – 5.8
Unit V	-	Chapter – 8	-	Section 6.1 – 6.6

Reference:

1. E.A.Coddington and N.Levinson , Theory of Ordinary Differential Equations, McGraw Hill, New York, 1955.
2. D.A.Sanchez, Ordinary Differential Equations and Stability Theory, W.H.Freeman & Co., San Francisco, 1968.

PAPER IV: NUMERICAL METHODS

Unit I:

SOLUTION OF NONLINEAR EQUATIONS:

Newton's method – Convergence of Newton's method – Bairstow"s Method for quadratic factors NUMERICAL DIFFERENTIATION AND INTEGRATION: Derivatives from Differences tables – Higher order derivatives – Divided difference, Central-Difference formulas – Composite formula of Trapezoidal rule – Romberg integration – Simpson's rules.

Unit II:

SOLUTION OF SYSTEM OF EQUATIONS:

The Elimination method – Gauss and Gauss Jordan methods – LU Decomposition method – Matrix inversion by Gauss-Jordan method – Methods of Iteration – Jacobi and Gauss Seidal Iteration – Relaxation method – Systems of Nonlinear equations.

Unit III:

SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS:

Taylor series method – Euler and Modified Euler methods – Rungekutta methods – Multistep methods – Milne's method – Adams Moulton method.

Unit IV:

BOUNDARY VALUE PROBLEMS AND CHARACTERISTIC VALUE PROBLEMS: The shooting method – solution through a set of equations – Derivative boundary conditions – Characteristic value problems – Eigen values of a matrix by Iteration – The power method.

Unit V:

NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS:

(Solutions of Elliptic, Parabolic and Hyperbolic partial differential equations) Representation as a difference equation – Laplace's equation on a rectangular region – Iterative methods for Laplace equation – The Poisson equation – Derivative boundary conditions – Solving the equation for time-dependent heat flow (i) The Explicit method (ii) The Crank Nicolson method – solving the wave equation by Finite Differences.

Treatment as in:

1. APPLIED NUMERICAL ANALYSIS' by C.F.Gerald and P.O.Wheatley, Fifth Edition, Addison Wesley, (1998).

Reference Book:

1. S.C. Chapra and P.C. Raymond: Numerical Methods for Engineers, tata McGraw Hill, New Delhi, (2000)
2. R.L. Burden and J. Douglas Faires: Numerical Analysis, P.W.S.Kent Publishing Company, Boston (1989), Fourth Edition.
3. S.S. Sastry: Introductory methods of Numerical Analysis, Prentice Hall of India, New Delhi, (1998).

PAPER V: COMPLEX ANALYSIS

Unit I:

Introduction to the concept of analytic function: Limits and continuity – Analytic functions – Polynomials – Rational functions – Conformality: Arcs and closed curves – Analytic functions in regions – Conformal Mapping – Length and Area – Linear Transformations: The Linear group – The Cross ratio – Elementary Riemann Surfaces.

Unit II:

Complex Integration: Line Integrals Rectifiable Arcs – Line Integrals as Functions of Arcs – Cauchy's theorem for a rectangle - Cauchy's theorem in a disk, Cauchy's Integral formula: The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives Removable singularities, Taylor's Theorem – Zeros and Poles – The Local Mapping – The Maximum principle – chains and cycles.

Unit III:

The Calculus of Residues: The Residue theorem – The Argument principle – Evaluation of definite integrals. Harmonic functions: The Definitions and basic Properties – Mean value property – Poisson's Formula.

Unit IV:

Series and Product Developments: Weierstrass Theorem – The Taylor Series – The Laurent Series – Partial fractions and Factorization: Partial Fractions – Infinite Products – Canonical Products.

Unit V:

The Riemann Mapping Theorem – Statement and Proff – Boundary Behaviour – Use of the reflection principle – Analytic arcs – Conformal mapping of Polygons: The Behaviour at an angle – The Schwarz – Christoffel Formula – Mapping on a rectangle.

Treatment as in:

Complex Analysis by L.V. Ahlfors, Mc Graw Hill, New York, 1979.

Unit I:	Chapter – 2	Sections 1.1 – 1.4
	Chapter – 3	Sections 2.1 – 2.4, 3.1, 3.2 and 3.4
Unit II:	Chapter – 4	Sections 1.1 – 1.5, 2.1 – 2.3, 3.1 - 3.4 and 4.1
Unit III:	Chapter – 4	Sections 5.1 – 5.3, 6.1 – 6.3
Unit IV:	Chapter – 5	Sections 1.1 – 1.3, 2.1 – 2.3
Unit V:	Chapter – 6	Sections 1.1 – 1.4, 2.1 – 2.3

PAPER VI: PARTIAL DIFFERENTIAL EQUATIONS

Unit I:

Mathematical Models: The Classical equation – The vibrating string – The vibrating membrane – Conduction of Heat in solids. Classification of second order equations: Second order equations in two independent variables – Cannonical forms – equations with constant coefficients – general solution.

Unit II:

The Cauchy problem: The Cauchy problem – Cauchy – Kowlalewsky theorem – Homogeneous wave equation – Initial – Boundary value problems – Non-homogeneous boundary conditions – Non-homogeneous wave equation, Riemann Method.

Unit III:

Methods of separation of variables: Seperation of variables – The vibrating string problem – Existence and Uniqueness of solution of the vibrating string problem. The heat conduction problem – existence and uniqueness of solution of the heat conduction problem – The laplace and beam equations.

Unit IV:

Boundary value problems: Boundary value problems – Maximum and minimum principles – Uniqueness and continuity theorems – Dirichlet problems for a circle – Dirichlet problems for a circular annulus – Neumann problem for a circle Drirchlet problem for a rectangle – Neumann problem for a rectangle.

Unit V

Green's function: The delta function – Green's function – method of Green's function – Dirichlet problem for the Laplace operator – method of images – method of eigen functions.

Treatment as in:

Partial Differential Equations for Scientists and Engineers, 3rd Edition, by Tyn Myint. U with Lokenath Debnath.

Unit I:	Chapter 2:	Sections 2.2 – 2.5 (omit 2.4)
	Chapter 3:	Sections 3.1 – 3.4
Unit-II:	Chapter 4:	Sections 4.1 – 4.8 (omit 4.6)
Unit-III:	Chapter 6:	Sections 6.2 – 6.6
Unit-IV:	Chapter 8:	Sections 8.1 – 8.9 (omit 8.8)
Unit-V:	Chapter 10:	Sections 10.1 – 10.7 (omit 10.5)

References:

1.I.N.Sneddon, Elements of Partial Differential Equations, McGraw Hill, London, 1957.
2.L.C.Evans, Partial Differential Equations, AMS, Providence, R I, 2003.

PAPER VII: MECHANICS

Unit-I:

INDRODUCTORY CONCEPTS: Mechanical system – Generalized Coordinates – Constraints – Virtual Work – Energy and Momentum.

Unit-II:

LAGRANGE'S EQUATIONS: Derivations of Lagrange's Equations: Derivations of Lagrange's Equations – Examples – Integrals of Motion.

Unit-III:

HAMITON'S EQUATIONS: Hamilton's Principle – Hamilton's Equations.

Unit-IV:

HAMILTON – JACOBI THEORY: Hamilton's Principle function – Hamilton – Jacobi Equation – Separability.

Unit-V:

CANONICAL TRANSFORMATIONS: Differential forms and Generating Functions – Lagrange and Poisson Brackets.

Treatment as in:
D.T.Greenwood: Classical Dynamics, Dover Publication, New York, 1997.

Unit-I:	Chapter 1:	Sections 1.1 – 1.5
Unit-II:	Chapter 2:	Sections 2.1 – 2.3
Unit-III:	Chapter 4:	Sections 4.1 – 4.2
Unit-IV:	Chapter 5:	Sections 5.1 – 5.3
Unit-V:	Chapter 6:	Sections 6.1, 6.3

References:

1. F. Gantmacher, Lectures in Analytic Mechanics, MIR Publishers, Moscow, 1975.
2. I.M. Gelfand and S.V. Fomin, Calculus of Variations, Prentice Hall.
3. S.L. Loney, An Elementary Treatise on Statics, Kalyani Publishers, New Delhi, 1979.

PAPER – VIII OPERATIONS RESEARCH

Unit I:

What is operation research? – Modeling with Linear Programming – Simplex method – Artificial starting solution – Special cases in the Simplex method.

Unit II:

Duality – Definition – Primal –Dual relationship – Dual simplex method – Transportation model – Assignment model.

Unit III:

Network models – Minimal spanning tree algorithm – Shortest root algorithm (Dijkstra's algorithm only) – CPM pert.

Unit IV:

Advanced linear programming – Simplex method – Fundamentals – Revised simplex method.

Unit V:

Simulation modeling – Monte Carlo simulation – Types of simulation – Elements of discrete event simulation – Generation of random numbers.

Treatment as in :

Operations Research: An Introduction, by H.A. Taha, Eighth Edition, Prentice Hall of India Private Limited, New Delhi (2006).

Unit I:	Chapter 1:	1
	Chapter 2:	2.1, 2.2.1, 2.2.2
	Chapter 3:	3.1.1, 3.1.2, 3.3.1, 3.3.2, 3.4.1, 4.2, 3.5.1 – 3.5.4
Unit-II:	Chapter 4:	4.1, 4.2.1, 4.2.2, 4.2.3, 4.2.4, 4.4.1
	Chapter 5:	5.1, 5.2, 5.3.1, 5.3.2, 5.4.1, 5.4.2
Unit-III:	Chapter 6:	6.1, 6.2, 6.3.1, 6.3.3, 6.5.1 – 6.5.5
Unit-IV:	Chapter 7:	7.1.1, 7.1.2, 7.2.1, 7.2.2
Unit-V:	Chapter 16:	16.1, 16.2, 16.3.1, 16.3.2, 16.4

References:

1.G.Dantzig, Linear Programming and Extension, Princeton University Press, Princeton , 1963.
2.S.Ross, A Course in Simulation, Macmillion, New York, 1990.

PAPER – IX TOPOLOGY

Unit I:

Topological spaces – Basis for a Topology – The Order Topology – Product Topology – Closed sets and Limit Points – Continuous Functions – Metric Topology.

Unit II:

Connectedness and Compactness: Connected Spaces – Connected sets in R – Components and path components – Local connectedness – Compact Spaces – Limit Point Compactness – Urysohn Metrization Theorem.

Unit III:

Countability and Separation Axioms: Countability Axioms – Separation Axioms Urysohn's Lemma – Urysohn Metrization Theorem.

Uni IV:

The Tychonoff Theorem – Completely regular spaces – The stone-Cech Compactification.

Unit V:

Complete Metric Spaces – Compactness in Metric Spaces – Pointwise and Compact Convergences – The Compact-Open Topology – Ascoil's Theorem – Baire Spaces – A Nowhere-Differentiable Function.

Text Book:

Topology; A First Course by James R. Munkres, Prentice Hall of India Private Limited, New Delhi, 2000.

Unit-I:	Chapter 2:	Sections 2.1 – 2.9
Unit-II:	Chapter 3:	Sections 3.1 – 3.8
Unit-III:	Chapter 4:	Sections 4.1 – 4.4
Unit-IV:	Chapter 5:	Sections 5.1 – 5.3
Unit-V:	Chapter 7:	Sections 7.1, 7.3 – 7.8

References:

1. J. Dugundji, Topology, Allyn and Bacon, 1966 (Reprinted in India by Prentice Hall of India Private Limited.).
2. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Book Company, 1963.
3. J.L. Kelley, General Topology, Van Nostrand, Reinhold Co., New York, 1995.
4. L. Steen and J. Seebach, Counter examples in Topology, Holt, Rinehart and Winston, New York, 1970.
5. R. Engelking, General Topology, Polish Scientific Publishers, Warszawa, 1977.
6. Sze – Tsen Hu, elements of General Topology, Holden – Day, Inc. 1965.

PAPER X: FLUID DYNAMICS

Unit I:

Introductory Notions – Velocity – Stream Lines and Path Lines – Stream Tubes and Filaments – Fluid Body – Density – Pressure. Differentiation following the Fluid – Equation of continuity – Boundary conditions – Kinematical and physical – Rate of change of linear momentum – Equation of motion of an inviscid fluid.

Unit II:

Euler's momentum Theorem – Conservative forces – Bernoulli's theorem in steady motion – energy equation for inviscid fluid – circulation – Kelvin's theorem – vortex motion – Helmholtz equation.

Unit III:

Two Dimensional Motion – Two Dimensional Functions – Complex Potential – basic singularities – source – sink – Vortex – doublet – Circle theorem. Flow past a circular cylinder with circulation – Blasius Theorem – Lift force. (Magnus effect)

Unit IV:

Viscous flows – Navier-Stokes equations – Vorticity and circulation in a viscous fluid – Steady flow through an arbitrary cylinder under pressure – Staedy Couettc flow between cylinders in relative motion – Steady flow between parallel planes.

Unit V:

Laminar Boundary Layer in incompressible flow: Boundary Layer concept – Boundary Layer equations – Displacement thickness, Momentum thickness – Kinetic energy thickness – integral equation of boundary layer – flow parallel to semi infinite flat plate – Blasius equation and its solution in series.

For Units I and II:

Treatment as in: Theoretical Hydro Dynamics by L.M. Milne Thomson, McMillan Company, 5th Edition (1968).

Chapter I : Sections 1.0 – 1.3., 3.10-3.41 (omit 3.32)
Chapter III : Sections 3.42 – 3.53 (omit 3.44)

For Units III, IV and V:

Treatment as in Modern Fluid Dynamics – (Volume I) by N. Curle aand H.J. Davies, D Van Nostrand Company Limited., London (1968).

Chapter III : Sections 3.1 – 3.7.5 (omit 3.3.4, 3.4, 3.5.2,3.6)
Chapter V : Sections 5.1 – 5.3.3
Chapter VI : Sections 6.1 – 6.3.1 (omit 6.2.2., 6.2.5)

PAPER XI: MATHEMATICAL STATISTICS

Unit I:

Random Events – Preliminary remarks – random events and operations performed on them – the system of axioms of the theory of probability – conditional probability – Bayes theorem – Independent Events – Random variables – the concept of a random variable – the distribution function – random variables of the discrete type and the continuous type – functions of random variables – Multidimensional random variables – marginal distributions – conditional distributions – Independent random variables – Parameters of the distributions of a random variable – expected values – moments – the Chebyshev inequality – absolute moments.

Unit II:

Characteristic functions – Properties of characteristic functions – the characteristic function and moments – semi-invariants – the characteristic function of the sum of independent random variables – Determination of the distribution function of multidimensional random vectors – probability – generating functions – some probability distributions - One point and two point distributions – the Bernoulli scheme. The binomial distribution – the Poisson scheme. The generalized binomial distribution – the Poisson scheme. The generalized binomial distributions and the Poisson distributions.

Unit III:

Some probability distributions – the uniform distribution - the normal distribution – the gamma distribution – the Cauchy and Laplace distributions – Limit theorems – preliminary remarks – Stochastic convergence – Bernoulli's law of large numbers - the convergence of a sequence of distribution functions – the Levy-Cramer theorem – The de Moivre Laplace theorem – the Lindeberg-Levy theorem.

Unit IV:

Sample moments and their functions – the notion of a sample – the notion of a Statistic – the distribution of the arithmetic mean of independent normally distributed random variables – the χ^2 distribution – the distribution of the statistic ($\overline{X}$,S) – student's t-distribution – Fisher's Z-distribution – Significance tests – the concept of a statistical test – parametric tests for small samples – parametric tests for large samples – the χ^2 test-independent tests by contingency tables.

Unit V: The theory of Estimation – preliminary notions – Consistent estimates – unbiased estimates – the sufficiency of an estimate – the efficiency of an estimates – Asymptotically most efficient estimates – methods of finding estimates – confidence intervals – Theory of Hypothesis testing – preliminary remarks – the power function and the OC function.

Treatment as in:

Probability Theory and Mathematical Statistics by Marek Fisz, John Wiley, 1980.

Chapter : 1, 2, 3, 4, 5, 6, 9, 12, 13, 16

Omit : 1.4, 3.8B, 5.3, 5.4, 5.11, 5.12, 5.13, 6.4, 6.5, 6.9, 6.10, 6.11, 6.12, 6.14, 9.7, 9.8, 9.9, 9.10, 12.5, 12.6, 13.9, 16.3, 16.4, 16.5, 16.6.

PAPER XIII: FUNCTIONAL ANALYSIS

Unit I:

Banach spaces – The definition and some examples – Continuous linear transformations – The Hahn-Banach theorem – The natural imbedding of N in N** - The open mapping problem.

Unit II:

The conjugate of an operator – Hilbert spaces – The definition and some simple properties – Orthogonal complements - Orthonormal sets.

Unit III:

The Conjugate space H* - The adjoint of an operator – Self-adjoint operators – Normal and unitary operators – Projections.

Unit IV:

Matrices – Determinants and the spectrum of an operator – The spectral theorem.

Unit V:

The definition and some examples of Banach algebra – Regular and singular elements – Topological divisors of zero – The spectrum – The formula for the spectral radius.

Treatment as in:

1. G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw –Hill Book Company, London, 1963.

Unit I:	Sections: 46 – 50.
Unit II:	Sections: 51 – 54.
Unit III:	Sections: 55 – 59.
Unit IV:	Sections: 60 – 63.
Unit V:	Sections: 64 – 68.

Reference Books:

1. C. Goffman and G. Pedrick, A First Course in Functional Analysis, Prentice Hall of India, New Deli, 1987.
2. G. Bachman and L. Narici, Functional Analysis, Academic Press, New York, 1966.
3. L.A. Lusternik and V.J. Sobolev, Elements of Functional Analysis, Hindustan Publishing Corporation, New Delhi, 1971.
4. A.E. Taylor, Introduction to Functional Analysis, John Wiley and Sons, New York, 1958.

PAPER XIV: MATHEMATICAL METHODS

Unit I:

FOURIER TRANSFORMS: Fourier sine and cosine transforms – Fourier transforms of derivatives - Fourier transforms of simple functions - convolution integral – Parseval's Theorem - Solution of PDE by Fourier transform – Laplace equation in half plane in infinite strips; in semi infinite strip. The Linear diffusion equation on a semi infinite line – the two dimensional diffusion equation.

Unit II:

HANKEL TRANSFORMS: Properties of Hankel Transforms – Hankel inversion theorem of derivatives of functions (proof deleted)- The Parseval's relation – relation between Fourier and Hankel transforms - Axisymmetric Dirichlet problem for a half space - Axisymmetric Dirichlet problem for a thick plate.

Unit III:

INTEGRAL EQUATIONS: Types of Integral equations – Integral Fredholm Alternative - Approximate method – Equation with separable Kernel - Volterra integral equations – Fredholm's theory – Fredholm's first, second, third theorems.

Unit IV:

Application of Integral equation to ordinary differential equation – initial value problems – Boundary value problems – singular integral equations – Abel Integral equation

Unit V:

CALCULUS OF VARIATIONS: Variation and its properties – Euler's equation – Functionals of the integral forms - Functional dependent on higher order derivatives – functionals dependent on the functions of several independent variables – variational problems in parametric form –applications.

Treatment as in: For Units I and II:
The Use of Integral Transforms by I.N.Sneddon, Tata Mc Graw Hill, New Delhi, 1974.
For Units III and IV:

Linear Integral Equations Theory and Technique by R.P.Kanwal, Academic Press, New York, 1971.

For Unit V:

Differential Equations and Calculus of Variations by L.Elsgolts, Mir Publishers, Moscow, 1970.

Unit I	:	Chapter 2:	2.4 - 2.7, 2.9 – 2.10, 2.16 – 2-(a).(b).(c) 2.16.		
Unit II	:	Chapter 5:	5.2 – 5.4, 5.6 – 5.7, 5.10 – 5.12.		
Unit III	:	Chapter 2:	2.3 - 2.5,	Chapter 3:	3.3 - 3.4.
Unit IV	:	Chapter 5:	5.1 – 5.2,	Chapter 8:	8.1 – 8.2.
Unit V	:	Chapter 6:	6.1 – 6.7.		

PAPER XV: COMPUTER PROGRAMMING

(C++ THEORY)

Unit I:

Principles of object-Oriented Programming: Software crisis – Software evolution – A look at procedure-oriented Programming – Object-oriented Programming Paradigm – Basic Concept of Object-Oriented Programming – Benefits of OOP – Object-Oriented languages – Applications of OOP.

Unit II:

Tokens, Expressions and Control structure: Introduction – Tokens – Keywords – Identifiers and constants – basic data types – User defined data types - Derived data types – Symbolic constants – type compactability – Declaration of variables – Dynamic insulation of variables – Reference variables – operations in C++ - Scope resolution operator – member Dereferencing operators – memory management operators – Manipulators – typr cast operator – expressions and their types – Special assignment expressions – implicit conversions – operator over loading – operator precedence – Control structures.

Unit III:

Functions in C++: Introduction – The main function – Function prototyping – call by reference – return by reference inline functions – default arguments – constant arguments – function over loading – friend and virtual functions – Math library functions –

Managing Console I/O operations: Introduction – C++ streams – C++ stream classes – Unformatted I/O operations - Formatted I/O operations – Managing output with manipulators.

Unit IV:

Classes and Objects: Introduction – C Structures Revisited – Specifying a class – Defining Member Functions – A C++ Program with class – Making an outside Function Inline – Nesting of Member Functions – Private Member Functions – Arrays within a class – Memory Allocation for Objects – Static Data Members – Static Member Functions – Arrays of Objects – Objects as Function Arguments – Friendly functions – Returning Objects – Constant Member Functions.

Constructors and Destructors: Introduction – Constructors – Parameterized Constructors – Multiple Constructors in a class – Constructors with Default Arguments – Dynamic Initializations of Objects – Copy Constructor – Constructing Two dimensional arrays – Constant Objects – Destructors.

Unit V:

Operators Overloading and Type Conversions: Introduction – Defining Operator Overloading – Overloading Unary Operators – Overloading Binary Operators – Overloading Binary Operators Using Friends – manipulating of strings Using Operators – Rules of Overloading Operators.

Inheritance: Extending Classes: Introduction – Defining Derived Classes – Single inheritance – Making a Private Member Inheritable – Multilevel Inheritance – Multiple

Inheritance – Hierachial Inheritance – Hybrid Inheritance – Virtual Base Classes – Abstract Classes – Constructors in Derived Classes – Member Classes: Nesting of Classes.

Treatment as in:

1. Object – Oriented Programming with C++ by E. Balaguruswamy, Tata McGraw-Hill Publishing Company limited, 1999.

Unit I	:	1.1 – 1.8
Unit II	:	3.1 – 3.24
Unit III	:	4.1 – 4.11 and 10.1 – 10.6
Unit IV	:	5.1 – 5.17, 6.1 – 6.7 and 6.9 – 6.11
Unit V	:	7.1 – 7.7 and 8.1 – 8.12

1. COMPUTER PRACTICAL

(Big questions – marked with * marks and small questions – without * marks)

Obtaining the root of a transcendental equation by Newton-Raphson Method.

*Solving a system of linear equations by Cramer's rule.

*Solving a system of linear equations by Gauss – elimination

*Obtaining the matrix inversion by Gauss Jordan method

*Solving a set of simultaneous linear equations by Jacobi Iteration Method.

*Solving a set of simultaneous linear equations by Gauss Seidal Iteration Method.

*Finding the eigenvalues and eigenvectors of a matrix.

*Interpolation using Newton forward difference formula.

*Interpolation using Newton backward difference formula.

Single Integration by Trapezoidal rule.

Single Integration by Simpson's 1/3 rule.

Single Integration by Simpson's 3/8 rule.

Solving ODE by Euler's Method.

Solving ODE by Second order Runge-Kutta Method.

Solving ODE by fourth order Runge-Kutta Method.

Solving ODE by Predictor-Corrector method.

Multiplication of two matrices.

Obtaining the trace of a matrix.

Pattern:
One question may be asked from the above list which are marked with asterisk(*) Marks.
OR
Two questions can be asked from the above list of questions without asterisk(*) Marks.

BOOKS FOR REFERENCE:

1. Computer and Computing with Fortran 77 by S.S. Alam & S.K.Sen. Oxford and IBH Publishing Pvt.Ltd., New Delhi (1988).

2. Numerical Algorithms – Computations in Science and Engineering – by E.V.Krishnamurthy & S.K.Sen, Affiliated East-West Press Pvt.Ltd., (1986)

3. Applied Numerical Analysis – By C.F.Gerald & P.O.Wheatley, Fifth Edition, Addison-Wesley Publishing Co., 1998.

2. C++ PRACTICAL

1. DISTANCE CONVERSION PROBLEM:

Create two classes DM and DB which store the value of distances. DM store the value of distances. DM stores distances in meters and centimeters in DB in feet and inches. Write a Program that can create the values of the class objects and add one object DM with another object DB.

Use a friend function to carry out addition operation. The object that stores the result may be DM object or DB object depending on the units in which results are required.

The display should be in the order of meter and centimeter and feet or inches depending on the order of display.

2. OVERLOADING OBJECTS:

Create a class FLOAT that contains one float data member overload all the four arithmetic operators so that operate on the objects of FLOAT.

3. OVERLOADING CONVERSIONS:

Design a class polar which describes a pant in a plane using polar Co-ordinates radius and angle. A point in polar Co-ordinates is as shown below.

Use the overloader + operator to add two objects of polar. Note that we cannot add polar values of two points directly. This requires first the conversion.

Points into rectangular Co-ordinates and finally converting the result into polar Co-ordinates.

You need to use following trigonometric formulas.

*X= r * cos (a);* *Y= r * sin (a);* a= $\tan^{-1}\left(Y/X\right)$; r = *sqrt (X * X +Y * Y);*

4. POLAR CONVERSION:

Define two classes polar and rectangular to represent points in the polar and rectangle systems. Use conversion routines to convert from one syatem to another.

5. OVRELOADING MATRIX:

Create a class MAT of size M*N. Define all possible matrix operations for MAT type objects. Verify the identity.

*(A-B)^2 = A^2+B^2 – 2*A*B*

6. AREA COMPUTATION USING DERIVED CLASS:

Area of rectangle = *X*Y*

Area of triangle = ½ * *X* * *Y*

7. VEXTOR PROBLEM:

Define a class for vector containing scalar values. Apply overloading concepts for vector addition, Multiplication of a vector by a scalar quantity, replace the values in a position vector.

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ELECTIVES

1. NUMBER THEORY

Unit I:

Introduction, Divisibility, Primes.

Unit II:

Congruences, solutions of congruences, Congruences of Degree 1. The functions $\phi(n)$, congruences of higher degree, Prime power moduli, Prime modulus.

Unit III:

Congruences degree 2, prime modulus, POWER Residues, Number theory from an algebraic view point , Multiplicative groups, Rings and fields, quadratic residues.

Unit IV:

Quadratic reciprocity – The Jacobi Symbol – Greatest integer function.

Unit V:

Arithmetic functions – The Moebius Inversion formula – The multiplication of arithmetic functions – Recurrence functions.

Treatment as in:

1. An Introduction to Theory of Numbers by Ivan Nivan and Herberts Zucherman.

Unit-I:	Chapter I:	Sections 1.1 – 1.3
Unit-II:	Chapter II:	Sections: 2.1 – 2.7
Unit-III:	Chapter II:	Sections: 2.8 – 2.11
	Chapter III:	Section: 3.1
Unit-IV:	Chapter III:	Sections: 3.2, 3.3
	Chapter IV:	Section: 4.1
Unit-V:	Chapter IV:	Sections: 4.2 – 4.5

Reference:

1. T.M. Apostol, Introduction to Analytic Number Theory, Springer Verlag, 1976.
2. Kennath and Rosan, Elementary Number Theory and its Applications, Addison Wesley Pulishing Company, 1968.
3. George E. Andrews, Number Theory, Hindustan Publishing, New Delhi, 1989.

2. GRAPH THEORY

Unit I:

Graphs, Subgraphs and Trees: Graphs and Subgraphs: Grpahs and Simple Graphs – Graph Isomorphism – The Incidence and Adjacency matrices – Subgraphs – Vertex Degrees – paths and Connection – Cycles.

Trees: Trees – Cut edges and Bonds – cut vertices – Cayley's formula

Unit II:

Connectivity, Euler tours and Hamilton Cycles: Connectivity: Connectivity – Blocks. Euler tours and Hamilton Cycles: Euler tours - Hamilton Cycles: Euler tours - Hamilton Cycles.

Unit III:

Matchings and Edge colourings: Matchings: Matchings coverings in Bipartite Graphs – Perfect Matchings.
Edge colourings: Edge chromatic number – Vizing's theorem.

Unit IV:

Independent sets, Cliques and Vertex Colourings: Independent sets, Cliques: Independent sets – Ramsey's theorem.
Vertex Colourings: Chromatic Number – Brook's Theorem – Hajos Conjecture – Chromatic Polynomials – Girth and Chromatic number.

Unit V:

Planar Graphs and Directed Graphs: Planar Graphs: Plane and planar Graphs – Dual Graphs – Euler's formula – Brides – Kuratowski's theorem (Proof omitted) – The Five Colour Theorem and the Four Colour Conjecture – Nonhamiltonian planar Graphs.

Simple problems in the exercise of all units can also be included.

Text Book:

1. J.A. Bondy and U.S.R. Murty, Graph Theory with Applications, American Elsevier Publishing Company., Inc., New York, 1976.

Unit-I:	Sections:	1.1 – 1.7 and 2.1 – 2.4.
Unit-II:	Sections:	3.1 – 3.2 and 4.1 – 4.2
Unit-III:	Sections:	5.1 – 5.3 and 6.1 – 6.2
Unit-IV:	Sections:	7.1 -7.2 and 8.1 – 8.5
Unit-V:	Sections:	9.1 – 9.7

3. MAGNETOHYDRO DYNAMICS

Unit I:

Electromagnetism – Fundamental Laws – Electrostatic Energy – Electrodynamics – Ampere's Law – Lorentz force on a moving charge – Magnetostatic Energy – Faraday's Law of Induction – Poynting stresses – Electromagnetic Equations with respect to moving axes – boundary conditions of electric and magnetic fields.

Unit II:

Kinematics of fluid motion – equation of continuity – Stress tensor – Navier-stokes equations – boundary condition – Velocity Magneto fluid dynamic equations – MHD

approximation – equation of Magnetic diffusion in a moving conducting medium – Magnetic Reynolds number.

Unit III:

Alfven's theorem Law of isorotation - Magneto hydrostatics – Force-free field – Alfven waves in incompressible MHD.

Unit IV:

Incompressible viscous flows in the presence of magnetic field – Hartmann Flow – unsteady Hartmann flow – Magnetofluid dynamic pipe flow.

Unit V:

Stability – Instability of linear pinch – Sausage and flute types – Method of small oscillations – gravitational instability.

Books:

1. Crammer K.R. and Pai S.I, Magneto Fluid Dynamics for Engineers and Applied Physicists, McGraw Hill, 1973.
2. Ferraro, VCA and Plumpton: Introduction to Magneto Fluid Dynamics, Oxford, 1966.

4. CONTROL THEORY

Unit I:

OBSERVABILITY:

Linear Systems – Observability Grammian – Constant coefficient systems – Reconstruction kernel – Nonlinear Systems

Unit II:

CONTROLLABILITY:

Linear systems – Controllability Grammian – Adjoint systems – Constant coefficient systems – steering function – Nonlinear systems

Unit III:

STABILITY:

Stability – Uniform Stability – Asymptotic Stability of Linear Systems - Linear time varying systems – Perturbed linear systems – Nonlinear systems

Unit IV:

STABILIZABILITY:

Stabilization via linear feedback control – Bass method – Controllable subspace – Stabilization with restricted feedback

Unit V:

OPTIMAL CONTROL:

Linear time varying systems with quadratic performance criteria – Matrix Riccati equation – Linear time invariant systems – Nonlinear Systems

Text Book:
Elements of Control Theory by K.Balachandran and J.P.Dauer, Narosa, New Delhi, 1999.
References:

1. Linear Differential Equations and Control by R.Conti, Academic Press, London, 1976.

2. Functional Analysis and Modern Applied Mathematics by R.F.Curtain and A.J.Pritchard, Academic Press, New York, 1977.

3. Controllability of Dynamical Systems by J.Klamka, Kluwer Academic Publisher, Dordrecht, 1991.

4. Mathematics of Finite Dimensional Control Systems by D.L.Russell, Marcel Dekker, New York, 1979.

5. E.B. Lee and L. Markus, Foundations of optimal Control Theory, John Wiley, New York, 1967

5. DIFFERENTIAL GEOMETRY

Unit I:

Curves: Analytic representation - Arc Length – Tangent - Osculation plane – Curvature torsion – Formulas of Frenet.

Unit II:

Contact – Natural equations – Helices – General solutions of Natural equations – Evolutes and Involutes.

Unit III:

Elementary theory of surface: Analytic representation – First fundamental form – Normal, Tangent plane – Developable surfaces.

Unit IV:

Second fundamental from – Meusnier's theorem – Euler's Theorem – Dupin's indicatrix – Some surfaces – The fundamental equations – The equations of Gauss-Weingarten.

Unit V:

The theorem of Gauss and the equations of Codazzi – Some applications of the Gauss and Codazzi equations. The fundamental theorem of surface theory – Geodesic curvature – Geodesics.

Text Book: D. Struik, Lectures on Classical Differential Geometry, Addison Wesley Publishing Company, 1961.

6. FUZZY LOGIC AND FUZZY SETS

Unit-1:

CRISP SETS AND FUZZY SETS:

Introduction-Crisp sets: An over view-The Notion of Fuzzy Sets-basic concepts of Fuzzy sets – Classical Logic: complement-Fuzzy Union-Fuzzy interaction – Combination of operations – general aggregation of operations.

Unit-2:

FUZZY RELATIONS:

Crisp and Fuzzy relations – Binary relations – Binary relations on a single set – Equivalence and similarity relations – Compatibility on Tolerance Relations-Orderings – Morphism – Fuzzy relations Equations.

Unit-3:

FUZZY MEASURES:

General discussion – Belief and plausibility Measures –Probability measures – Possibility and Necessity measures – Relationship among Classes of Fuzzy Measures.

Unit-4:

UNCERTAINTY AND INFORMATION:

Types of Uncertainty – Measures of Fuzziness-Classical Measures of Uncertainty – Measures of Dissonance-Measures of Confusion – Measures of Non-Specificity – Uncertainty and Information – Information and Complexity – Principles of Uncertainty and information.

Unit-5:

APPLICATIONS:

Natural, life and Social Sciences - Engineering - Medicine - Management and decision making – Computer Sciences-System Science-Other Applications.

Text Book:

1. George J. Klir and Tina A. Folger, Fuzzy Sets, Uncertainty and Information, Prentice-Hall of India Private Limited-Fourth printing-June 1995
   (Treatment as in Chapeters 1 to 6)

Reference Book:

1. George J. Klir and Boyuan**,** Fuzzy Sets and Fuzzy Logic-Theory and Applications, Prentice-Hall of India Private Limited.

7. CRYPTOGRAPHY

Unit I:

Introduction – Encryption and Secrecy – The objective of Cryptography – Cryptographic protocols. Mathematical background – Number Theory – Introduction – Modular Arithmetic – Integer factorization problem – Pollard's rho factoring – Elliptic curve factoring – Discreate logarithm problem

Unit II:

Finite fields – Basic properties – Arithmetic of polynomials –Factoring polynomials over finite fields – Square free factorization

Unit III: Symmetric key encryption – Stream ciphers – Block Ciphers – DES

Unit IV:

Public key cryptography – Concepts of public key cryptography – Modular arithmetic – RSA – Discrete logarithm – Elliptic curve cryptography

Unit V:

Protocols and mechanisms - Key establishment, management and certification – Pseudorandom numbers and sequences – classes of attacks and security models

Reference Books:

1. Hans Delfs, Helmut Knebl, Introduction to Cryptography, Springer Verlag, 2002
2. Alfred J. Menezes, Paul C. Van Oorschot, Scott A. Vanstone, Handbook of Applied Cryptography, CRC Press, 2000
3. William Stallings, Cryptography and Network Security, Prentice Hall of India, 2000

8. NEURAL NETWORKS

UNIT I:

Mathematical Neuron Model- Network Architectures- Perceptron-Hamming Network-Hopfield Network-Learning Rules-Perceptron Architectures and Learning Rule with Proof of Convergence.

UNIT II:

Supervised Hebbian Learning-Linear Associator-The Hebb Rule-Pseudo inverse Rule-Variations of Hebbian Learning-Back Propagation-Multilayer Perceptrons-Back propagation Algorithm-Convergence and Generalization.

UNIT III:

Performances Surfaces and Optimum Points-Taylor series-Directional Derivatives-Minima-Necessary Conditions for Optimality-Quadratic Functions-Performance Optimizations-Steepest Descent-Newton's Method-Conjugate Gradient.

UNIT IV:

Associative Learning-Simple Associative Network-Unsupervised Hebb rule-Simple Recognition Network-Instar Rule-Simple Recall Network-Outatar Rule-Competitive Networks-Hamming Network- Competitive Layer-Self Organizing Feature maps- Learning Vector Quantization.

UNIT V:

Adaptative Resonance Theory-Overview of Adaptative Resonance Theory-Orienting Sub System- Learning Law L I-L2 and L2-L1. ART I Algorithm-Other ART Architectures-Stability-Recurrent Networks- Stability Concepts-Lyapunov Stability Theorem-Pendulum Example-Lasalle's Invariance Theorem.

Text Book: Martin T.Hagan, Howard B. Demuth and Mark Beale, Neural Network Design, Vikas Publishing House, New Delhi,2002.
Chapters : 2,3,4,7,8,9,11,14,16,17.

Reference Books:

1. James A. Freeman, David M. Skapura, Neural Networks Algorithms, Applications and Programming Techniques, Pearson Education, 2003.

2. Robert J. Schalkoff, Artificial Neural Network, McGraw-Hill International Edition, 1997.

9. STOCHASTIC DIFFERENTIAL EQUATIONS

Unit I

Introduction: Stochastic Analogs of Classical Differential Equations, Filtering Problems, Stochastic Approach to Deterministic Boundary Value Problems, Optimal Stopping, Stochastic Control and Mathematical Finance. Some mathematical preliminaries: Probalitity Spaces, Random Variables and Stochastic Processes and an Important Example: Brownian Motion.

Unit II

Ito Integrals: Construction of the Ito integral , Some Properties of the Ito Integral and Extensions of the Ito Integral.

Unit III

The Ito formula and the Martingale Representation Theorem: The 1- dimentional Ito Formula, the Multi dimensional Ito Formula and the Martingale Reprsentation Theorem. Stochastic Differential Equations: Examples and Some Solution Methods, An Existence and Uniqueness Result and Weak and Strong Solutions.

Unit IV

The Filtering problem: Introduction, The 1- dimentional Linear Filtering Problem and the Multi- dimentional Linear Filtering Problem.

Unit V

Diffusions: Basic Properties: The Markov Property, the Strong Markov Property, the Generator of an Ito Diffusion, the Dynkin Formula, the Characteristic Operator.

Text Book:

"Stochastic Differential Equations - An Introduction with Applications", by **Bernt Oksendal**, (Sixth Edition), Springer-Verlag, Heidelberg, 2003.

Unit I : Chapter 1 and 2
Unit II : Chapter
Unit III: Chapter 4 and 5
Unit V : Chapter 7.
Unit IV: Chapter 6

DIPLOMA GROUP A – DIPLOMA IN MATHEMATICAL SOFTWARE
PAPER – I : LATEX

Unit I:

Text formatting, TEX and its offspring, What's different in LATEX 2ϵ, Distinguishing LATEX 2ϵ , Basics of a LATEX file.

Unit II:

Commands and Environments–Command names and arguments, Environments, Declarations, Lengths, Special Characters, Fragile Commands, Exercises.

Unit III:

Document Layout and Organization – Document class, Page style, Parts of the document, Table of contents, Fine – Tuning text, Word division.

Displayed Text - Changing font, Centering and indenting, Lists, Generalized lists, Theorem–like declarations, Tabulator stops, Boxes.

Unit IV:

Tables, Printing literal text, Footnotes and marginal notes. Drawing pictures with LATEX.

Unit V:

Mathematical Formulas – Mathematical environments, Main elements of math mode, Mathematical symbols, Additional elements, Fine–tuning mathematics.

Treatment as in:

A Guide to LATEX by H. Kopka and P.W. Daly, Third Edition, Addison – Wesley, London, 1999.

Unit I : Chapter 1 : Sections : 1.1-1.3, 1.4.1, 1.5.
Unit II : Chapter 2 : Sections : 2.1-2.7.
Unit III : Chapter 3 : Sections : 3.1-3.6, 4.1-4.7
Unit IV : Chapter 4 : Sections : 4.8-4.10, 6.1.
Unit V : Chapter 5: Sections : 5.1-5.5.

DIPLOMA GROUP A – DIPLOMA IN MATHEMATICAL SOFTWARE
PAPER – II : MATLAB

Unit – I

Introduction - Basics of MATLAB, Input – Output, File trypes – Platform dependence – General commands.

Unit – II

Interactive Computation: Matrices and Vectors – Matrix and Array operations – Creating and Using *Inline* functions – Using Built-in Functions and On-line Help – Saving and loading data – Plotting simple graphs.

Unit – III

Programming in MATLAB: Scripts and Functions – Script files – Functions files- Language specific features – Advanced Data objects.

Unit – IV

Applications – Linear Algebra – Curve fitting and Interpolation – Data analysis and Statistics – Numerical Integration – Ordinary differential equations – Nonlinear Algebraic Equations.

Unit – V

Graphics: Basic 2-D Plots – Using subplot to Layout multiple graphs - 3 – D Plots – Handle Graphics – Saving and printing Graphs – Errors.

Treatment as in:

RUDRA PRATAP, Getting Started with MATLAB – A Quick Introduction for Scientists and Engineers, Oxford University Press, 2003.

Reference Books:

1. William John Palm, Introduction to Matlab 7 for Engineers, McGraw-Hill Professional, 2005.
2. Dolores M. Etter, David C. Kuncicky , Introduction to MATLAB 7, Prentice Hall, 2004

DIPLOMA GROUP A – DIPLOMA IN MATHEMATICAL SOFTWARE
PAPER – III : MATHEMATICA

Unit – I: Introduction to *Mathematica*

Running *Mathematica* - Numerical Calculations – Building Up calculations – Using the Mathematica system – Algebraic calculations - Symbolic Mathematics - Numerical Mathematics.

Unit – II

Functions and Programs – Lists – Graphics – Input and Output in Notebooks – The structure of Graphics.

Unit – III: Advanced Mathematics in *Mathematica*

Mathematical Functions – Algebraic Manipulation – Manipulating Equations - Calculus.

Unit - IV

Series, Limits and Residues - Linear Algebra – Constructing matrices – Getting pieces of matrices – Scalars, Vectors and Matrices – Operations on scalars, vectors and matrices – Multiplying Vectors and matrices – Matrix inversion – Basic matrix operations – Solving linear systems – Eigen values and Eigen vectors.

Unit – V

Numerical operations on data – Curve fitting – Approximate functions and Interpolation – Fourier Transforms.

Numerical operations on functions – Numerical Integration – Numerical evaluation of sums and products – Numerical Solution of Polynomial equations – Numerical root finding – Numerical solution of Differential equations -

Treatment as in:

Stephen Wolfram, **The Mathematica Book**, Fifth Edition, Cambridge University Press, 2003

DIPLOMA GROUP A – DIPLOMA IN MATHEMATICAL SOFTWARE
PAPER IV : PRACTICALS

Implementing the Algorithms of any one of the softwares in Papers I to III above.

DIPLOMA GROUP B – DIPLOMA IN MATHEMATICAL FINANCE

Paper I - PROBABILITY THEORY

Unit I:
What is Probability? Random Variables and Measurability Results, Expectations and the Lebesgue Theory, Image Measure and the Fundamental Theorem of Probability.

Unit II:
Independence and Strong Convergence- Independence – Convergence Concepts, Series and Inequalities.

Unit III:
Law of Large Numbers, Applications to Empiric Distributions, Densities, Queuing and Random walk.

Unit IV:
Conditional Expectation, Conditional Probabilities.

Probability Distributions and Characteristic Functions - Distribution Functions and Selection Principle – Characteristic Functions, Inversion, and Levy's Continuity Theorem

Unit V:
Weak limit Laws – Classical Central Limit Theorems.

Treatment as in

Probability Theory with Applications by M.M. Rao, Academic Press, 1984.

DIPLOMA GROUP B – DIPLOMA IN MATHEMATICAL FINANCE

Paper II- STOCHASTIC PROCESSES

Unit I:

Some Mathematical Preliminaries – Probability Spaces, Random Variables and Stochastic Processes, an Important Example: Brownian motion.

Unit II:

Itô Integrals - Construction of the Itô Integral, Some Properties of the Itô Integral, Extensions of the Itô Integral.

The Itô Formula and the Martingale Representation Theorem - The 1-dimensional Itô Formula, the Multi-dimensional Itô Formula, The Martingale Representation Theorem.

Unit III:

Stochastic Differential Equations – Examples and Some Solution Methods, an Existence and Uniqueness Result, Weak and Strong Solutions.

Unit IV:

The Filtering Problem – Introduction, the 1-Dimensional Linear Filtering Problem, The Multidimensional Linear Filtering Problem.

Unit V:

Diffusions: Basic Properties – The Markov Property, the Strong Markov Property, The Generator of an Itô Diffusion, The Dynkin Formula, The Characteristic Operator.

Treatment as in *Stochastic Differential Equations* by B. Oksendal, Sixth Edition, Springer - Verlag, Heidelberg, 2003.

Unit I : Chapter 2 : Sections : 2.1, 2.2.
Unit II : Chapter 3: Sections : 3.1-3.3
Chapter 4 : Sections : 4.1-4.3.
Unit III : Chapter 5 : Sections : 5.1-5.3.
Unit IV : Chapter 6 : Sections : 6.1-6.3.
Unit V : Chapter 7: Sections : 7.1-7.5.

DIPLOMA GROUP B – DIPLOMA IN MATHEMATICAL FINANCE

Paper III- MATHEMATICAL FINANCE – I

UNIT I INTRODUCTION AND MECHANICS OF MARKETS

Contracts – Options – Hedgers – Arbitrageurs – Background – Daily settlement – Delivery – Regulations – Accounting and Tax.

UNIT II: HEDGING, AND INTEREST RATES

Basis risk – Cross hedging – Stock index futures - Types of rates – Bond pricing – Forward rates – Duration – Convexity.

UNIT III: FUTURES PRICES AND RATE FUTURES

Short selling – Forward price – Known yield – Valuing forward contracts – Futures on commodities – Delivery options – Expected future spot prices -Day count conventions – Treasury bond futures – Hedging portfolios –.

UNIT IV: SWAPS AND MECHANICS

Mechanics of Swaps – Confirmations – Nature – Valuation – Credit risk – Types of options – Underlying assets – Trading – Commissions – Margins – Regulation – Taxation – Warrants.

UNIT V: PROPERTIES OF OPTIONS AND TRADING STRATEGIES

Factors affecting options – Upper and Lower bounds for options – Put-Call parity – Early exercises – Effects of dividends - Strategies involving a single option and a stock – Spreads – Combinations – Other payoffs.

Treatment as in:

"*Options, Futures, and Other Derivatives*" by John C.Hull, Sixth Edition, Pearson Education, New Delhi (2006).

UNIT I : Chapter 1 & 2
UNIT II : Chapter 3 & 4
UNIT III : Chapter 5 & 6
UNIT IV : Chapter 7 & 8
UNIT V : Chapter 9 & 10.

Reference:

1. "An elementary Introduction to Mathematical Finance" by S.M.Ross, First South Asian Edition, Cambridge University Press, Chennai (2005).
2. "Stochastic Calculus and Financial Applications" by J.M.Steele, Springer series on Applications of Mathematics Vol- 45, Newyork (2000).

DIPLOMA GROUP B – DIPLOMA IN MATHEMATICAL FINANCE
Paper IV- MATHEMATICAL FINANCE – II

UNIT I BINOMIAL TREE AND ITO'S LEMMA

One-step binomial model – Two step binomial trees – American options – Delta – Options on other assets – The Markov property – Ito's lemma (including derivations)– The Lognormal property.

UNIT II: THE BLACK-SCHOLES-MERTON MODEL

The expected return – Volatility- Concepts underlying the Black-Scholes-Merton equation – Derivation – Risk-neutral valuation – Black-Scholes pricing formulas – Warrants and executive stock options – Implied volatilities – Dividends.

UNIT III: VARIOUS OPTIONS AND THE GREEK LETTERS

Option pricing formulas – Options on stock indices – Currency options – Futures options – Black's model – Naked and covered positions – Delta hedging – Relationship between delta, theta and gamma – Vega – Rho – Scenario analysis – Stock market volatility.

UNIT IV: VOLATILITY SMILES AND BASIC NUMERICAL PROCEDURES

Put-Call parity – Equity options – Greek letters –Binomial trees – Application on various options, dividend paying stock – Time dependent parameters – Monte Carlo simulation – Finite difference methods.

UNIT V: THE VaR MEASURE AND ESTIMATING VOLATILITIES

The VaR measure – Model-building approach – Linear, Quadratic models – Comparison – Stress testing and back testing – Estimating Volatility – Choosing models – Maximum likelihood models – Correlations.

Treatment as in:

"*Options, Futures, and Other Derivatives*" by John C.Hull, Sixth Edition, Pearson Education, New Delhi (2006).

UNIT I : Chapter 11 & 12
UNIT II : Chapter 13
UNIT III : Chapter 14 & 15
UNIT IV : Chapter 16 & 17
UNIT V : Chapter 18 & 19.

Reference:

1. "An elementary Introduction to Mathematical Finance" by S.M.Ross, First South Asian Edition, Cambridge University Press, Chennai (2005).
2. "Stochastic Calculus and Financial Applications" by J.M.Steele, Springer series on Applications of Mathematics Vol- 45, New York (2000)