DEPARTMENT OF MATHEMATICS
SCHOOL OF MATHEMATICS AND COMPUTER SCIENCE
BHARATHIDASAN UNIVERSITY
TIRUCHIRAPPALLI – 620 024

M.Sc., PROGRAMME IN MATHEMATICS (CBCS PATTERN)

(For the candidates to be admitted from the year 2006-2007 onwards)

Semester	Paper	Course Title	Hours per Week	Credits	Exam Hours	Marks		Total
						CIA	ESE	
I	Core Course – I (CC)	Linear Algebra	6	4	3	40	60	100
	Core Course – II (CC)	Real Analysis	6	4	3	40	60	100
	Core Course – III (CC)	Ordinary Differential Equations	6	4	3	40	60	100
	Core Course – IV (CC)	Theory of Numbers	6	4	3	40	60	100
	Elective Course – I (EC)	*	6	4	3	40	60	100
II	Core Course – V (CC)	Algebra	6	4	3	40	60	100
	Core Course – VI (CC)	Topology	6	4	3	40	60	100
	Core Course – VII (CC)	Partial Differential Equations	6	4	3	40	60	100
	Elective Course – II (EC)	*	6	4	3	40	60	100
	Extra Disciplinary Course – I (EDC)	#	3	2	3	40	60	100
III	Core Course – VIII (CC)	Measure Theory and Integration	6	4	3	40	60	100
	Core Course – IX (CC)	Probability Theory	6	4	3	40	60	100
	Core Course – X(CC)	Complex Analysis	6	4	3	40	60	100
	Elective Course – III (EC)	*	6	4	3	40	60	100
	Extra Disciplinary Course – II (EDC)	#	3	2	3	40	60	100
IV	Core Course – XI (CC)	Functional Analysis	6	4	3	40	60	100
	Core Course – XII (CC)	Differential Geometry	6	4	3	40	60	100
	Core Course – XIII (CC)	Fluid Dynamics	6	4	3	40	60	100
	DISSERTATION +			4				100
				72		720	1080	1900

CIA - Continuous Internal Assesment.
ESE - End Semester Examination.
+ - Evaluation 75 Marks, Viva-Voce 25 Marks.

* ELECTIVE COURSES

Elective – I (any one)

1. Tensor Analysis and Special Theory of Relativity
2. Combinatorics
3. Graph Theory
4. Optimization Techniques
5. C++ and Numerical Methods

Elective – II (any one)

6. Classical Dynamics
7. Methods of Mathematical Physics
8. Analytic Number Theory
9. Fuzzy Sets and Their Applications
10. Internet Programming and Java

Elective – III (any one)

11. Mathematical Statistics
12. Stochastic Processes
13. Integral Equations, Calculus of variations and Fourier Transform
14. Discrete Dynamical Systems
15. Relational Database Management software (RDBMS)

EXTRA-DISCIPLINARY COURSES offered by the Department of Mathematics to non-Mathematics PG students

1. C Programming and Numerical Methods & Practicals
2. Fuzzy Mathematics
3. Mathematical Modelling
4. Statistics

CORE COURSES

LINEAR ALGEBRA

UNIT I

Systems of linear Equations – Matrices and Elementary Row operations – Row - Reduced echelon Matrices – Matrix Multiplication – Invertible Matrices – Vector spaces – Subspaces – Bases and Dimension – Computations concerning Subspaces.

UNIT II

The algebra of linear transformations – Isomorphism of Vector Spaces – Representations of Linear Transformations by Matrices - Linear Functionals - The Double Dual – The Transpose of a Linear Transformation.

UNIT III

The algebra of polynomials – Lagrange Interpolation – Polynomial Ideals – The prime factorization of a polynomial, Commutative rings – Determinant functions – Permutations and the uniqueness of determinants – Classical Adjoint of a (Square) matrix – Inverse of an invertible matrix using determinants.

UNIT IV

Characteristic values – Annihilating polynomials, Invariant subspaces – Simultaneous triangulation and simultaneous Diagonalization – Direct-sum Decompositions.

UNIT V

Invariant Direct sums – The Primary Decomposition Theorem – Cyclic subspaces – Cyclic Decompositions and the Rational Form. – The Jordan Form – Computation of Invariant Factors and Smith Normal Form.

TEXT BOOK(S)

Kenneth Hoffman and Ray Kunze, Linear Algebra, Second Edition, Prentice – Hall of India Private Limited, New Delhi :1975.

UNIT – I - Chapters 1 and 2
UNIT – II - Chapter 3
UNIT – III - Chapter 4 and Chapter 5: Sections 5.1 to 5.4
UNIT – IV - Chapter 6: Sections 6.1 to 6.6
UNIT – V - Sections 6.7 and 6.8 and Chapter 7: Sections 7.1 to 7.4

REFERENCE(S)

[1] I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, New Delhi, 1975.
[2] I.S. Luther and I.B.S. Passi, Algebra, Vol.I – Groups, Vol.II- Rings, Narosa Publishing House (Vol.I – 1996, Vol.II- 1999)
[3] N. Jacobson, Basic Algebra, Vols. I & II, Freeman, 1980 (also published by Hindustan Publishing Company)

REAL ANALYSIS

UNIT I

Basic Topology: Finite, Countable and Uncountable Sets – Metric spaces – Compact sets – Perfect sets – Connected sets.

UNIT II

Numerical Sequences and Series: Sequences – Convergence – Subsequences - Cauchy Sequences – Upper and Lower Limits - Some Special Sequences – Tests of convergence – Power series – Absolute convergence – Addition and multiplication of series – Rearrangements.

UNIT III

Continuity: Limits of functions – Continuous functions – continuity and Compactness – Continuity and connectedness – Discontinuities – Monotonic functions – Infinite limits and limits at infinity. Differentiation: Derivative of a real function – Mean value Theorems - Intermediate value theorem for derivatives – L'Hospital Rule – Taylor's Theorem – Differentiation of vector valued functions.

UNIT IV

Sequences and series of functions: Uniform Convergence and Continuity – Uniform Convergence and Differentiation – Equicontinuous families of functions – The Stone – Weierstrass Theorem.

UNIT V

Functions of several variables: Directional Derivatives – Total derivative – Chain rule – Mean Value theorem -– The Inverse Function Theorem - The Implicit Function Theorem.

TEXT BOOK(S)

[1] Walter Rudin, Principles of Mathematical Analysis Third Edition, Mcgraw Hill, 1976.

[2] Tom M. Apostol, Mathematical Analysis 2 edn, Narosa Publishing House, New Delhi, 1985.

UNIT – I -Chapters 2 from [1]
UNIT – II -Chapters 3 from [1]
UNIT – III -Chapter 4 and 5 from [1]
UNIT – IV -Chapter 7 from [1]
UNIT – V -Chapter 12 , Sections 12.1 -12.13 from [2] and
-Chapter 13, Sections 13.1 to 13.4 from [2]

REFERENCE(S)

[1] R. G. Bartle, The Elements of Real Analysis 2 edn, J. Willey, 2003, Newyork
[2] A.J. White, Real Analysis : An Introduction, Addison Wesley Publishing Co., Inc. 1968.
[3] Serge Lang, Analysis I & II, Addison-Wesley Publishing Company, Inc. 1969.

ORDINARY DIFFERENTIAL EQUATIONS

UNIT I

The general solution of the homogeneous equation – The use of one known solution to find another – The method of variation of parameters – Power Series solutions. A review of power series – Series solutions of first order equations – Second order linear equations; Ordinary points.

UNIT II

Regular Singular Points – Gauss's hypergeometric equation – The Point at infinity - Legendre Polynomials – Bessel functions – Properties of Legendre Polynomials and Bessel functions.

UNIT III

Linear Systems of First Order Equations – Homogeneous Equations with Constant Coefficients – The Existence and Uniqueness of Solutions of Initial Value Problem for First Order Ordinary Differential Equations – The Method of Solutions of Successive Approximations and Picard's Theorem.

UNIT IV

Oscillation Theory and Boundary value problems – Qualitative Properties of Solutions – Sturm Comparison Theorems – Eigenvalues, Eigenfunctions and the Vibrating String.

UNIT V

Nonlinear equations: Autonomous Systems; the phase plane and its phenomena – Types of critical points; Stability – critical points and stability for linear systems – Stability by Liapunov's direct method – Simple critical points of nonlinear systems.

TEXT BOOK(S)

G.F. Simmons, Differential Equations with Applications and Historical Notes, TMH, New Delhi, 1984.

UNIT – I -Chapter 3: Sections 15, 16, 19 and Chapter 5: Sections 25 to 27
UNIT – II -Chapter 5 : Sections 28 to 31 and Chapter 6: Sections 32 to 35
UNIT – III -Chapter 7: Sections 37, 38 and Chapter 11: Sections 55, 56
UNIT – IV -Chapter 4: Sections 22 to 24
UNIT – V -Chapter 8: Sections 42 to 44

REFERENCE(S)

[1] W.T. Reid, Ordinary Differential Equations, John Wiley & Sons, New York, 1971.
[2] E.A. Coddington and N. Levinson, Theory of Ordinary Differential Equaitons, McGraw Hill Publishing Company, New York, 1955.
[3] DePrimov, Ordinary Differential Equations and Boundary Value Problems, 7^{th} Edn.

THEORY OF NUMBERS

UNIT I

Introduction – Divisibility – Primes – The Binomial Theorem – Congruences – Euler's totient - Fermat's, Euler's and Wilson's Theorems – Solutions of congruences – The Chinese Remainder theorem.

UNIT II

Techniques of numerical calculations – Public key cryptography – Prime power Moduli – Primitive roots and Power Residues –Congruences of degree two.

UNIT III

Number theory from an Algebraic Viewpoint – Groups, rings and fields – Quadratic Residues- The Legendre symbol (a/r) where r is an odd prime – Quadratic Reciprocity – The Jacobi Symbol (P/q) where q is an odd positive integer

UNIT IV

Binary Quadratic Forms – Equivalence and Reduction of Binary Quadratic Forms – Sums of three squares – Positive Definite Binary Quadratic forms – Greatest integer Function – Arithmetic Functions – The Mobius Inversion Formula – Recurrence Functions – Combinatorial number theory

UNIT V

Diophantine Equations – The equation ax+by=c – Simultaneous Linear Diophantine Equations – Pythagorean Triangles – Assorted examples

TEXT BOOK(S)

[1] Ivan Niven, Herbert S, Zuckerman and Hugh L, Montgomery, An Introduction to the Theory of Numbers, Fifth edn., John Wiley & Sons Inc, 2004

UNIT I Chapter 1 and Chapter 2 : Sections 2.1 to 2.3
UNIT II Chapter 2 : Sections 2.4 to 2.9
UNIT III Chapter 2 : Sections 2.10, 2.11 and Chapter 3: Sections 3.1 to 3.3
UNIT IV Chapter 3 : Sections 3.4 to 3.7 and Chapter 4
UNIT V Chapter 5: Sections 5.1 to 5.4

REFERENCE(S)

[1] David M. Burton, Elementary Number Theory, W.M.C. Brown Publishers, Dubuque, Lawa, 1989.
[2] George Andrews, Theory of Numbers.
[3] Fundamentals of Number Theory, William.J. Leveque, Addison-Wesley Publishing Company, Phillipines, 1977.

ALGEBRA

UNIT I

Preliminaries regarding sets, mappings, permutations, basic concepts of theory of numbers Groups- subgroups, Normal subgroups- Homomorphisms - permutation groups- Automorphisms - Conjugate elements.

UNIT II

Sylow theorems - Direct product of groups- fundamental structure theorem for finite Abelian groups.

UNIT III

Rings – Ideals-Operations on Ideals – Ring homomorphisms- imbeddings of Rings- Maximal Ideals- Euclidean domains- prime and irreducible elements in an integral domain, polynomial rings- unique factorization domains.

UNIT IV

Finite and Algebraic Extensions- Algebraic closure splitting fields and normal extensions- separable extensions, finite fields-primitive elements.

UNIT V

Fundamental theorem of Galois theory- Galois extensions, examples and applications of Galois theory.

Note: Appropriate modification in the way of presentation in some places and appropriate corrections in some places will have to be made in the Text book (1) by the teacher concerned. For example, on page 128 D_{2n} must be changed to D_n and the existence of a group which is generated by two elements x, y such that x has order 2, y has order n and $xy = y^{-1}x$ is to be established in some way or other by the teacher concerned.

TEXT BOOKS

1. Vijay K. Khanna and S.K. Bhambri, A Course in Abstract Algebra, Vikas publishing house private Ltd. 1993

   UNIT –I Chapter 1 to 4
   UNIT – II Chapter 5
   UNIT – III Chapters 6, 7, 8

2. Serge Lang. Algebra, Addions, Wesley publishing company 1965.

   UNIT – IV Chapter VII: Sections 1 to 6
   UNIT –V Chapter VIII: Sections 1,2

TOPOLOGY

UNIT I

TOPOLOGICAL SPACES : Topological spaces - Basis for a topology - The order topology - The product topology on X x Y - The subspace topology - Closed sets and limit points.

UNIT II

CONTINUOUS FUNCTIONS : Continuous functions - the product topology - The metric topology.

UNIT III

CONNECTEDNESS: Connected spaces- connected subspaces of the Real line - Components and local connectedness.

UNIT IV

COMPACTNESS: Compact spaces - compact subspaces of the Real line - Limit Point Compactness – Local Compactness.

UNIT V : COUNTABILITY AND SEPARATION AXIOMS

The Countability Axioms - The separation Axioms - Normal spaces - The Urysohn Lemma - The Urysohn metrization Theorem - The Tietz extension theorem.

TEXT BOOK(S)

James R. Munkres, Topology (2nd Edition) Pearson Education Pvt. Ltd., New Delhi-2002 (Third Indian Reprint)

UNIT – I -Chapter 2: Sections 12 to 17
UNIT – II -Chapter 2 : Sections 18 to 21 (Omit Section 22)
UNIT – III -Chapter 3 : Sections 23 to 25.
UNIT – IV -Chapter 3 : Sections 26 to 29.
UNIT – V -Chapter 4 : Sections 30 to 35.

REFERENCE(S)

1. J. Dugundji, Topology, Prentice Hall of India, ,New Delhi, 1975.
2. K.D. Joshi, Introduction to General Topology, Wiley Eastern Ltd., 1983.
3. J.L. Kelly, General Topology, Van Nostrand, Reinhold Co., New York
4. L.Steen and J.Seeback, Counter examples in Topology, Holt, Rinehart and Winston, New York, 1970.
5. S.Willard, General Topology, Addison - Wesley, Mass., 1970

PARTIAL DIFFERENTIAL EQUATIONS

UNIT I

First Order P.D.E. – Curves and Surfaces – Genesis of First Order P.D.E. – Classification of Integrals – Linear Equations of the First Order – Pfaffian Differential Equations – Compatible Systems – Charpit's Method – Jacobi's Method

UNIT II

Integral Surfaces Through a Given Curve – Quasi-Linear Equations – Non-linear First Order P.D.E.

UNIT III

Second Order P.D.E.: Genesis of Second Order P.D.E. – Classification of Second Order P.D.E. One-Dimensional Wave Equation – Vibrations of an Infinite String – Vibrations of a Semi-infinite String –Vibrations of a String of Finite Length (Method of separation of variables)

UNIT IV

Laplace's Equation: Boundary Value Problems – Maximum and Minimum Principles – The Cauchy Problem – The Dirichlet Problem for the Upper Half Plane – The Neumann Problem for the Upper Half Plane – The Dirichlet Interior Problem for a Circle - The Dirichlet Exterior Problem for a Circle – The Neumann Problem for a Circle – The Dirichlet Problem for a Rectangle – Harnack's Theorem .

UNIT V

Heat Conduction Problem – Heat Conduction –Infinite Rod Case – Heat Conduction Finite Rod Case – Duhamel's Principle – Wave Equation – Heat Conduction Equation

TEXT BOOK(S)

T.Amarnath, An Elementary Course in Partial Differential Equations , Narosa Publishing Company, 1997.

UNIT – I -Chapter 1: Sections 1.1 to1.8
UNIT – II -Chapter 1: Sections 1.9 to1.11
UNIT – III -Chapter 2: Sections 2.1 to 2.3.5, except 2.3.4
UNIT – IV -Chapter 2: Sections 2.4 to 2.4.11
UNIT – V -Chapter 2: Sections 2.5 to 2.6.2

REFERENCE(S)

[1] I.C. Evans, Partial Differential Equaitons, Graduate Studies in Mathematics, Vol. 19 AMS, 1998.
[2] I.N. Snedden, Elements of Partial Differential Equations.
[3] F. John, P. Prasad, Partial Differential Equations.

MEASURE THEORY AND INTEGRATION

UNIT I

Riemann – Stieltjes Integral: Definition – Properties – Comparison theorems, Necessary conditions for existence – Mean value theorems – Fundamental theorems of Integral Calculas – Lebesegue's criterion for existence.

UNIT II

Measure on R: - outer measure - measurable sets - sigma algebra – abstract Measures – elementary properties of abstract measures.

UNIT III

Integration of positive functions - Integration of complex functions – convergence theorems - The role played by sets of measure zero.

UNIT IV

Integration on Product Spaces- Measurability on products Product measures - The Fubini theorem - convolutions.

UNIT V:

L^p spaces – completeness – – Radon Nikodyn Theorem – Consequences – Dual of L^p spaces.

Text Books:

1. Tom M. Apostol, Mathematical Analysis 2 edn, Narosa Publishing House, New Delhi, 1985.
2. H.L.Roydan,Real Analysis, Prentice Hall of India ,3edn .,1989.
3. W. Rudin, Real and Complex Analysis 3edn, McGraw-Hill, 1987.

Unit I Chapter 7 from [1]
Unit II Chapter 3 from [2] and Chapter 1 - pages 5 -19 from [3].
Unit III : Chapter 1 - pages 19 -31 from [3].
Unit IV : Chapter 8 - pages 160-172 from [3]

Unit V : Chapter 3 pages 61-69 from [3] and Chapter 6 pages 116 -128 from [3]

REFERENCES

[1] C.D. Aliprantis and O.Burkinshaw, Priniciples of Real Analysis 2edn, Academic Press, Inc. New York, 1990
[2] I.K.Rana, An Introduction to Measure and Integration 2edn ,Narosa Publishing House,NewDelhi, 2005.
[3] G. de Barra, Measure Theory And Integration, NewAge International Pvt.Ltd.

PROBABILITY THEORY

UNIT I

Random Events and Random Variables - Random events – Probability axioms – Combinatorial formulae – conditional probability – Bayes Theorem – Independent events – Random Variables – Distribution Function – Joint Distribution – Marginal Distribution – Conditional Distribution – Independent random variables – Functions of random variables.

UNIT II

Parameters of the Distribution - Expectation- Moments – The Chebyshev Inequality – Absolute moments – Order parameters – Moments of random vectors – Regression of the first and second types.

UNIT III

Characteristic functions - Properties of characteristic functions – Characteristic functions and moments – semi-invariants – characteristic function of the sum of the independent random variables – Determination of distribution function by the Characteristic function – Characteristic function of multidimensional random vectors – Probability generating functions.

UNIT IV

Some Probability distributions - One point , two point , Binomial – Polya – Hypergeometric – Poisson (discrete) distributions – Uniform – normal gamma – Beta – Cauchy and Laplace (continuous) distributions.

UNIT V

Limit Theorems - Stochastic convergence – Bernaulli law of large numbers – Convergence of sequence of distribution functions – Levy-Cramer Theorems – de Moivre-Laplace Theorem – Poisson, Chebyshev, Khintchine Weak law of large numbers – Lindberg Theorem – Lapunov Theroem – Borel-Cantelli Lemma - Kolmogorov Inequality and Kolmogorov Strong Law of large numbers.

TEXT BOOKS:

M. Fisz, *Probability Theory and Mathematical Statistics,* John Wiley and Sons, New York, 1963.

UNIT – I	Chapter 1: Sections 1.1 to 1.7, Chapter 2 : Sections 2.1 to 2.9
UNIT – II	Chapter 3 : Sections 3.1 to 3.8
UNIT – III	Chapter 4 : Sections 4.1 to 4.7
UNIT – IV	Chapter 5 : Section 5.1 to 5.10 (Omit Section 5.11)
UNIT – V	Chapter 6 : Sections 6.1 to 6.4, 6.6 to 6.9 , 6.11 and 6.12. (Omit Sections 6.5, 6.10,6.13 to 6.15)

REFERENCES:

1. R.B. Ash, *Real Analysis and Probability*, Academic Press, New York, 1972
2. K.L.Chung, *A course in Probability*, Academic Press, New York, 1974.
3. Y.S.Chow and H.Teicher*, Probability Theory*, Springer Verlag. Berlin, 1988 (2nd Edition)

4. R.Durrett, *Probability : Theory and Examples*, (2nd Edition) Duxbury Press, New York, 1996.

5. V.K.Rohatgi *An Introduction to Probability Theory and Mathematical Statistics*, Wiley Eastern Ltd., New Delhi, 1988(3rd Print).

6. S.I.Resnick, *A Probability Path*, Birhauser, Berlin,1999.

7. B.R.Bhat , *Modern Probability Theory* (3rd Edition), New Age International (P)Ltd, New Delhi, 1999

8. J.P. Romano and A.F. Siegel, *Counter Examples in Probability and Statistics,* Wadsworth and Brooks / Cole Advanced Books and Software, California, 1968.

COMPLEX ANALYSIS

UNIT I

Geometrical Representation – Analytical Geometry – Spherical Representation- Lucas theorem - Power Series – Abels Limit Theorem; Exponential and Trigonometric Functions- Logarithms: Conformality: Arcs and Closed Curves – Analytic Functions in Regions – Conformal Mapping – Length and Area; Linear Transformations: The Linear Group – The Cross Ratio – Symmetry – Circles.

UNIT II

Fundamental theorems in 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.

UNIT III

Local Properties of Analytic Functions - Removable Singularities - Taylor's Theorem – Integral representation of the n^{th} term - Zeros and Poles – Algebraic order of f(z) – Essential Singularity - The Local Mapping – The Open Mapping Theorem - The Maximum Principle.

UNIT IV

The General Form of Cauchy's Theorem: Chains and Cycles – Simple Connectivity – Homology – The General Statement of Cauchy's Theorem – Proof of Cauchy's Theorem. The Calculus of Residues: The Residue Theorem – The Argument Principle.

UNIT V

Harmonic Functions: Definition and Basic Properties – The Mean-value Property – Poisson's Formula – Schwarz's Theorem – The Reflection Principle; Power series expansions- Taylor's- Laurent's series.

TEXT BOOK(S)

Lars V. Ahlfors, Complex Analysis, Third Ed. McGraw-Hill Book Company, Tokyo, 1979.

UNIT – I Chapter 1 Sections 2.3-2.4 and Chapter 2 Sections 1.1–1.4, 2.4-2.5,3.1-3.4
Chapter 3: Sections 2.1-2.4,3.1-3.5
UNIT – II -Chapter 4:Sections 1.1-1.5, 2.1-2.3
UNIT – III -Chapter 4: Sections 3.1-3.4
UNIT – IV -Chapter 4: Sections 4.1-4.5 and 5.1 – 5.2
UNIT – V -Chapter 4: Sections 6.1-6.5 and Chapter 5 : Section 1.1-1.3.

REFERENCE(S)

[1] W. Rudin, Real and Complex Analysis 3edn, McGraw-Hill, 1987.
[2] V. Karunakaran, Complex Analysis 2 edn, Narosa, New Delhi, 2005.
[3] Serge Lang, Complex Analysis, Addison Wesley, 1977.
[4] S. Ponnusamy, Foundations of Complex Analysis 2 edn, Narosa, New Delhi, 2005.

FUNCTIONAL ANALYSIS

UNIT I

Normed Linear Spaces : Norm on a linear space – Banach spaces–Riesz Lemma – Best Approximation Theorems – Projection Theorem.

UNIT II

Operators on Normed Linear Spaces: Bounded operators : The space B(X,Y). Riesz Representation Theorem - Convergence of sequence of operators – Closed Operators.

UNIT III

More about Hilbert Spaces: – Orthonormal sets – Bessel's Inequality – Parseval's Formula – Riesz – Fischer Theorem. Hahn Banach Theorem and Its Consequences – Separation Theorem.

UNIT IV

Uniform Boundedness principle: The theorem and its consequences - Closed Graph Theorem – Open Mapping theorem – Bounded Inverse Theorem.

UNIT V

Dual Spaces: Dual of some sequence spaces – Reflexivity – Weak Convergence. Eigenspectrum and Approximate Eigenspectrum – Spectrum and Resolvent Set.

Note: Regarding L^p spaces, a review from Measure theory course has to be presented in appropriate places (for example in Unit I and Unit V) omitting the proofs.

TEXT BOOK

M.T. Nair, Functional Analysis: A first course, Prentice Hall of India, New Delhi, 2002..

UNIT – I -Chapter 2
UNIT – II -Chapter 3
UNIT – III -Chapter 4 and 5
UNIT – IV - Chapter 6 and Chapter 7
UNIT – V -Chapter 8 (all sections except 8.1.3) and Chapter 10 Sections 10.1, 10.2.

REFERENCE(S)

[1] G.F.Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill International Ed. 1963.
[2] B.V. Limaye, Functional Analysis, Wiley Eastern Limited, Bombay, Second Print, 1985.
[3] K. Yosida, Functional Analysis, Springer-Verlag, 1974.

DIFFERENTIAL GEOMETRY

UNIT I

SPACE CURVES: Definition of a space curve - Arc length - tangent - normal and binormal - curvature and torsion - contact between curves and surfaces- tangent surface- involutes and evolutes- Intrinsic equations - Fundamental Existence Theorem for space curves- Helics.

UNIT II

INTRINSIC PROPERTIES OF A SURFACE: Definition of a surface - curves on a surface - Surface of revolution - Helicoids - Metric- Direction coefficients - families of curves- Isometric correspondence- Intrinsic properties.

UNIT III

GEODESICS: Geodesics - Canonical geodesic equations - Normal property of geodesics- Existence Theorems - Geodesic parallels - Geodesics curvature- Gauss- Bonnet Theorem - Gaussian curvature- surface of constant curvature.

UNIT IV

NON INTRINSIC PROPERTIES OF A SURFACE: The second fundamental form- Principal curvature - Lines of curvature - Developable – Developable associated with space curves and with curves on surface - Minimal surfaces - Ruled surfaces.

UNIT V

DIFFERENTIAL GEOMETRY OF SURFACES: Compact surfaces whose points are umblics- Hilbert's lemma - Compact surface of constant curvature - Complete surface and their characterization - Hilbert's Theorem - Conjugate points on geodesics.

TEXT BOOK(S)

[1] T.J. Willmore, An Introduction to Differential Geometry, Oxford University Press,(17th Impression) New Delhi 2002. (Indian Print).

UNIT – I Chapter I : Sections 1to 9.
UNIT – II Chapter II: Sections 1 to 9.
UNIT – III Chapter II: Sections 10 to 18.
UNIT – IV Chapter III: Sections 1 to 8.
UNIT – V Chapter IV : Sections 1 to 8

REFERENCE(S)

1. Struik, D.T. Lectures on Classical Differential Geometry, Addison - Wesley, Mass. 1950.
2. Kobayashi S. and Nomizu. K. Foundations of Differential Geometry, Interscience Publishers, 1963.
3. Wihelm Klingenberg: A course in Differential Geometry, Graduate Texts in Mathematics, Springer Verlag, 1978.
4. J.A. Thorpe Elementary topics in Differential Geometry, Under - graduate Texts in Mathematics, Springer - Verlag 1979.

FLUID DYNAMICS

UNIT I

Real Fluids and Ideal Fluids - Velocity of a Fluid at a point - Streamlines and Path lines; Steady and Unsteady Flows - The Velocity potential – The Vorticity vector - Local and Particle Rates of Change – The Equation of continuity - Worked examples - Acceleration of a Fluid - Pressure at a point in a Fluid at Rest - Pressure at a point in Moving Fluid - Conditions at a Boundary of Two Invisid Immiscible Fluids - Euler's equations of motions - Bernoulli's equation - worked examples – Conditions at a regid boundary – General analysis of fluid motion.

UNIT II

Discussion of a case of steady motion under conservative body forces – Some potential theorems-Some Flows Involving Axial Symmetry - Some special two-Dimensional Flows - Impulsive Motion. Some three-dimensional Flows: Introduction - Sources, Sinks and Doublets - Images in a Rigid Infinite Plane - Axi-Symmetric Flows ; Stokes stream function

UNIT III

Some Two-Dimensional Flows: Meaning of a Two-Dimensional Flow - Use of cylindrical Polar coordinates – The stream function – The Complex Potential for Two-Dimensional, Irrotational, Incompressible Flow - complex velocity potentials for Standard Two-Dimensional Flows - Some worked examples – The Milne-Thomson circle theorem and applications – The Theorem of Blasius

UNIT IV

The use of conformal Transformation and Hydrodynamical Aspects - Vortex rows.

- stress components in Real fluid - relations between Cartesian components of stress - Translational Motion of Fluid Element - The Rate of Strain Quadric and Principal Stresses - Some Further properties of the Rate of Strain Quadric - Stress Analysis in Fluid Motion - Relations Between stress and rate of strain - The coefficient of viscosity and Laminar Flow - The Navier - Stokes equations of Motion of a Viscous Fluid –

UNIT V

Some solvable problems in Viscous Flow - Steady Viscous Flow in Tubes of Uniform cross section - Diffusion of Vorticity - Energy Dissipation due to Viscosity - Steady Flow past a Fixed Sphere - Dimensional Analysis; Reynolds Number - Prandtl's Boundary Layer

TEXT BOOK(S)

[1] Content and Treatment as in Text Book of Fluid Dynamics by F. Chorlton (CBS Publishers & Distributors, New Delhi-110 032) 1985.

UNIT – I Chapter 2: Sections 2.1 to 2.11 and Chapter 3: Sections 3.1 to 3.6
UNIT – II Chapter 3: Sections 3.7 to 3.11 and Chapter 4: Sections 4.1, 4.2, 4.3, 4.5
UNIT – III Chapter5 : Sections: 5.1 to 5.9 except 5.7
UNIT – IV Chapter 5: Section 5.10 , 5.12 and Chapter 8: Sections 8.1 to 8.9
UNIT – V Chapter 8: Sections 8.10 to 8.16

REFERENCE(S)

[1] J.F. Wendt, J.D. Anderson, G.Degrez and E. Dick, Computational Fluid Dynamics : An Introduction, Springer-Verlag, 1996.

[2] J.D. Anderson, Computational Fluid Dynamics, The Basics with Applications, McGraw Hill, 1995.

[3] G.K. Batchelor, An Introduction to Fluid Mechanics, Foundation Books, New Delhi, 1984.

[4] A.J. Chorin and A. Marsden, A Mathematical Introduction to Fluid Dynamics, Springer-Verlag, New York, 1993.

[5] S.W. Yuan, Foundations of Fluid Mechanics, Prentice Hall of India Pvt Limited, New Delhi, 1976.

[6] R.K. Rathy, An Introduction to Fluid Dynamics, Oxford and IBH Publishing Company, New Delhi, 1976.

ELECTIVE PAPERS

TENSOR ANALYSIS AND SPECIAL THEORY OF RELATIVITY

UNIT I

Invariance - Transformations of coordinates and its properties - Transformation by invariance - Transformation by covariance and contra variance - Covariance and contra variance - Tensor and Tensor character of their laws - Algebras of tensors - Quotient tensors - Symmetric and skew symmetric tensors – Relative tensors.

UNIT II

Metric Tensor - The fundamental and associated tensors - Christoffel's symbals - Transformations of Chrisffel's symbols- Covariant Differentiation of Tensors - Formulas for covariant Differentiation- Ricci Theorem - Riemann -Christoffel Tensor and their properties.

UNIT III

Einstein Tensor - Riemannian and Euclidean Spaces (Existence Theorem) - The e-systems and the generalized Kronecker deltas - Application of the e-systems.

UNIT IV

Special Theory of Relativity: Galilean Transformation - Maxwell's equations - The ether Theory – The Principle of Relativity Relativistic Kinamatics : Lorentz Transformation equations - Events and simultaneity - Example Einstein Train - Time dilation - Longitudinal Contraction -Invariant Interval - Proper time and Proper distance – World line - Example - twin paradox - addition of velocities - Relativistic Doppler effect.

UNIT V

Relativistic Dynamics : Momentum – energy – Momentum-energy four vector – Force – Conservation of Energy – Mass and energy – Example – inelastic collision – Principle of equivalence – Lagrangian and Hamiltonian formulations .
Accelerated Systems : Rocket with constant acceleration – example – Rocket with constant thrust .

TEXT BOOK(S)

[1] I.S. Sokolnikoff, Tensor Analysis, John Wiley and Sons, New York, 1964
[2] D. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985

UNIT I Chapter 2 : Sections 18 to 28 of [1]
UNIT II Chapter 2 : Sections 29 to 37 of [1]
UNIT III Chapter 2 : Sections 38 to 41 of [1]
UNIT IV Chapter 7 : Sections 7.1 and 7.2 of [2]
UNIT V Chapter 7 : Sections 7.3 and 7.4 of [2]

REFERENCE(S)

1. J.L. Synge and A.Schild, Tensor Calculus, Toronto, 1949.
2. A.S. Eddington, The Mathematical Theory of Relativity, Cambridge University Press, 1930.
3. P.G. Bergman, An Introduction to Theory of Relativity, New York, 1942.
4. C.E. Weatherburn, Riemannian Geometry and Tensor Calculus, Cambridge, 1938.

COMBINATORICS

UNIT I

Permutations and combinations - distributions of distinct objects ~ distributions of non distinct objects - Stirlings formula.

UNIT II

Generating functions. - generating function for combinations - enumerators for permutations - distributions of distinct objects into non-distinct cells - partitions of integers – the Ferrers graphs - elementary relations. .

UNIT III

Recurrence relation - linear recurrence relations with constant coefficients solutions by the technique of generating functions - a special class of nonlinear difference equations - recurrence relations with two indices.

UNIT IV

The principle of inclusion and exclusion - general formula - permutations with restriction on relative positions - derangements - the rook polynomials - permutations with forbidden positions.

UNIT V

Polya's theory of counting - equivalence classes under a permutation group Burnside theorem - equivalence classes of functions - weights and inventories of functions - Polya' s fundamental theorem – generation of Polya’s theorem

TEXT BOOK(S)

[1] C.L. Liu - Introduction to Combinatorial Mathematics, McGraw Hill, Chapters 1 to 5.

REFERENCE(S)

[1] Marshall Hall. Jr., Combinatorial Theory.
[2] H.J. Rayser, Combinatorial Mathematics, Carus, Mathematical Monograph, No.14

GRAPH THEORY

UNIT – I

Graphs, subgraphs and Trees: Graphs and simple graphs - Graph Isomorphism - The Incidence and Adjacency Matrices - Subgraphs - Vertex Degrees - Paths and Connection - Cycles - Trees - Cut Edges and Bonds - Cut Vertices – Cayley's formula.

UNIT II

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

UNIT III

Matchings, Edge Colourings : Matchings - Matchings and Coverings in Bipartite Graphs – Perfect Matching ; Edge Chromatic Number - Vizing's Theorem.

UNIT IV

Independent sets and Cliques, Vertex Colourings : Independent sets - Ramsey's Theorem :. Chromatic Number - Brooks' Theorem - Chromatic Polynomials.

UNIT V

Planar graphs: Plane and planar Graphs - Dual graphs - Euler's Formula - The Five- Colour Theorem and the Four-Colour Conjecture; Directed Graphs.

TEXT BOOK(S)

[1] J.A.Bondy and U.S.A. Murthy, Graph Theory and Applications, Macmillan, London, 1976.

UNIT I Chapter 1 (Section 1.1 - 1.7), Chapter 2 (Section 2.1 - 2.4)
UNIT II Chapter 3 (Section 3.1 - 3.2), Chapter 4 (Section 4.1 - 4.2)
UNIT III Chapter 5 (Section 5.1 - 5.3), Chapter 6 (Section 6.1 - 6.2)
UNIT IV Chapter 7 (Section 7.1 - 7.2), Chapter 8 (Section 8.1 - 8.2, 8.4)
UNIT V Chapter 9 (Section 9.1 - 9.3, 9.6) Chapter 10 (Section 10.1 – 10.3)

REFERENCE(S)

1. J.Clark and D.A.Holton, A First look at Graph Theory, Allied Publishers, New Delhi, 1995.
2. R. Gould. Graph Theory, Benjamin/Cummings, Menlo Park, 1989.
3. A.Gibbons, Algorithmic Graph Theory, Cambridge University Press, Cambridge, 1989.
4. R.J..Wilson. and J.J.Watkins, Graphs: An Introductory Approach, John Wiley and Sons, New York, 1989.
5. S.A.Choudum, A First Course in Graph Theory, MacMillan India Ltd. 1987.

OPTIMIZATION TECHNIQUES

UNIT I

Integer programming

UNIT II

Dynamic (Multistage) programming,

UNIT III

Decision Theory and Games.

UNIT IV

Inventory Models.

UNIT V

Non-Linear Programming algorithms.

TEXT BOOK(S)

[1] Hamdy A. Taha, Operations Research (7^{th} Edn.), McGraw Hill Publications, New Delhi.2002.

UNIT I Sections 8.1 to 8.5
UNIT II Sections 9.1 to 9.5
UNIT III Sections 11.1 to 11.4
UNIT IV Sections 13.1 to 13.4
UNIT V Sections 19.1 and 19.2.

REFERENCE(S)

[1] O.L. Mangasarian, Non Linear Programming, McGraw Hill, New York.
[2] Mokther S. Bazaraa and C.M. Shetty, Non Linear Programming, Theory and Algorithms, Willy, New York.
[3] Prem Kumar Gupta and D.S. Hira, Operations Research : An Introduction, S. Chand and Co., Ltd. New Delhi,
[4] S.S. Rao, Optimization Theory and Applications, Wiley Eastern Limited, New Delhi.

C++ AND NUMERICAL METHODS

UNIT I

Tokens, Expressions and Control Structures – Functions in C++

UNIT II

Classes and Objects – Constructors and Destructors – Operator Overloading and Type conversions

UNIT III

Inheritance – Pointers – Virtual Functions and Polymorphism

UNIT IV

The solution of Nonlinear Equations f(x)=0 - Interpolation and Polynomial Approximation

UNIT V

Curve Fitting and Solution of Differential Equations

TEXT BOOKS

[1] E. Balagurusamy, Programming in C++

UNIT –I	Chapters: 3 and 4
UNIT – II	Chapters : 5, 6 and 7
UNIT – III	Chapters 8 and 9

[2] John H.Mathews, Numerical Methods for Mathematics, Science and Engineering (2^{nd} Edn.), Prentice Hall, New Delhi, 2000

UNIT – IV	Chapter2: Sec. 2.1 to 2.7 Chapter 4: 4.1 to 4.4 (omit Sec. 4.5 & 4.6)
UNIT – V	Chapter 5: Sec. 5.1 to 5.3 (omit Sec. 5.4) Chapter 9: Sec. 9.1 to 9.6 (omit 9.7 to 9.9)

Computer Laboratory Practice Exercises : (10 marks)

(Laboratory Examination : 30 marks and Record : 10 Marks)

(Section I : 15 marks ; Section II : 15 marks and Record : 10 marks.)

Section I (15 marks) : Computer Language Exercises for Programming in C++ :

1 a) Define a class to represent a bank account. Include the following members : Name, Acc-no, Acc-Type, Balance. Member functions: To assign initial values, Deposit an amt, withdraw an amt after checking the balance . Write a main program to test the program for handling 10 customers.

1 b) Write a class to represent a vector (a series of float values). Include member functions to perform the following tasks: To create the vector, To modify the value of a given element, To multiply by a scalar value, To display the vector in the form (10, 20, 30,…). Write a program to test your class.

2 a) Create two classes **DM** and **DB** which store the value of distances**. DM** stores distances in meters and centimeters and **DB** in feet and inches. Write a program that can read values for the class objects and add one object **DM** with another object **DB**. Use a friend function to carry out the addition operation. The object that stores the results may be a **DM** object or **DB** object, depending on the units in which the results are required. The display should be in the format of feet and inches or meters and centimeters depending on the object on display.

2 b) Create a class **FLOAT** that contains one float data member. Overload all the four arithmetic operators so that they operate on the objects of **FLOAT**.

3 a) Define a class **string**. Use overloaded == operator to compare two strings.

3 b) Write a class called employee that contains a name and an employee number. Include a member function to get data from the user for insertion into object, and another function to display the data. Write a main() program to create an array of employee information and accept information from the user and finally print the information.

4 a) Write a function called zersmaller() that is passed two arguments to reference and then sets the smaller of the two numbers to 0. Write a main() program to exercise this function.

4 b) Write a program which shows the days from the start of year to date specified. Hold the number of days for each month in an array. Allow the user to enter the month and the day of the year. Then the program should display the total days till the day.

5 a) Write a function called reversit() that reverse a string (an array of char). Use the for loop that swaps the first and last characters, then the second and next-to-last characters and so on. The string should be passed to reversit() as argument. Write a program to exercise reversit(). The program should get a string from the user, call reversit(), and print out the result. Use an input method that allows embedded blanks.

5 b) Write a program to use a common friend function to exchange the private values of two classes.

6 a) Write a program to read a set of integer numbers from the keyboard as long as the operator does not want to exit and find the maximum number entered. Use a constructor to count the number of integers entered. This counter should be initialized to 0. Use a constructor to initialize it.

6 b) Write a program to include all possible binary operator overloading using friend function.

7 a) Write a program to read an array of integer numbers and sort it in descending order. Use readdata, putdata, and arraymax as member functions in a class.

7 b) Write a program to read two values of time and to find the greater of the two overload the '<' operator for comparison.

8 a) Write a program that has a class PUB with two derived classes BOOK and TAPE. Each of the 3 classes should have getdata() and putdata() functions to accept and display data respectively.

8 b) Write a program to read two character strings and use the overloaded '+' operator to append the second string to the first.

9 a) Write a program to accept employee information such as name, number and salary of 3 employees and display the record of the employee chosen by the user using pointers.

9 b) Write a function that takes two Distance values as arguments and returns the larger one. Include a main() program that accept two Distance values from the user, compare them and displays the larger.

10 a) Implement the concept of overloading Binary operator using friend function.

10 b) Write a program to implement the concept of object as function argument and returning objects.

11 a) Write a program for maintaining Employee Information System using Hierarchical Inheritance and stream.

11 b) Write a program to reverse a given string. "The world of computers is exciting" using pointers.

12. Develop a program Railway Reservation System using Hybrid Inheritance and Virtual Function.

13 a) i) Write a program for swapping 2 numbers using reference arguments.
ii) Write a program using inline function.

13 b) Using overloaded constructor in a class write a program to add two complex numbers.

14 a) Write a program to read the starting time of an event and the duration, the time at which the event will end. Define time as a class & start, duration, finish as objects belonging to class time. Define a function which will take as argument values of time add them and return the result.

14 b) Create a class MAT of size(m,n). Define all possible matrix operations for MAT type objects.

15 a) Write a program that determines whether a given number is a prime number or not and then prints the result using polymorphism.

15 b) Write a program to solve the general quadratic equation $ax^2 + bx + c = 0$ using the polymorphic technique.

Sections II (15 marks) Numerical Methods Exercises for Programming in C++:

1. Non-Linear Equations
   1.1 Bisection Method
   1.2 Regula-falsi Method
   1.3 Newton-Raphson Method
   1.4 Secant Method
   1.5 Fixed Point Iteration

2. Interpolation
   2.1 Lagrange's Interpolation Formula
   2.2 Newton Interpolation Formula

3. Curve Fitting
   3.1 Least-Square line
   3.2 Least-Square polynomial
   3.3 Non linear curve fitting

4. Numerical Solution to Differential Equations
   4.1 Euler's Method
   4.2 Taylor's Method of order 4
   4.3 Runge-Kutta Method of order 4
   4.4 Milne-Simpson Method

CLASSICAL DYNAMICS

UNIT I

Introductory concepts: The mechanical system - Generalised Coordinates - constraints - virtual work - Energy and momentum.

UNIT II

Lagrange's equation: Derivation and examples - Integrals of the Motion - Small oscillations.

UNIT III

Special Applications of Lagrange's Equations: Rayleigh's dissipation function - impulsive motion - Gyroscopic systems - velocity dependent potentials.

UNIT IV

Hamilton's equations: Hamilton's principle - Hamilton's equations - Other variational principles - phase space.

UNIT V

Hamilton - Jacobi Theory: Hamilton's Principal Function – The Hamilton - Jacobi equation - Separability.

TEXT BOOK(S)

[1] Donald T. Greenwood, Classical Dynamics, PHI Pvt. Ltd., New Delhi,1985.

UNIT – I -Chapter 1: Sections 1.1 to 1.5
UNIT – II -Chapter 2: Sections 2.1 to 2.4
UNIT – III -Chapter 3 : Sections 3.1 to 3.4
UNIT – IV -Chapter 4: Sections 4.1 to 4.4
UNIT – V -Chapter 5: Sections 5.1 to 5.3

REFERENCE(S)

[1] H. Goldstein, Classical Mechanics, (2nd Edition), Narosa Publishing House, New Delhi.
[2] Narayan Chandra Rana & Promod Sharad Chandra Joag, Classical Mechanics, Tata McGraw Hill, 1991.

METHODS OF MATHEMATICAL PHYSICS

UNIT I

Boundary value problems and series solution - Examples of boundary value problems - Eigen values, eigen functions and the Sturm-Liouville problem - Hermitian operator, their eigen values and eigen functions.

UNIT II

Bessel functions - Bessel functions of 'the second kind, Hankel functions Spherical Bessel functions - Legendre polynomials - Associated Legendre polynomials and spherical harmonics.

UNIT III

Hermite polynomials - Legendre polynomials - The Gamma function - The Dirac Delta function

UNIT IV

Non homogeneous boundary value problems and Green's function - Green's function for one-dimensional problems - eigen function expansion of Green's function - Fourier transform method of constructing Green's function.

UNIT V

Green's function in higher dimensions - Green's function for Poisson's equation and a formal solution of electrostatic boundary value problems ~ Wave equation with source - the quantum mechanical scattering problem.

TEXT BOOK(S)

[1] P.K. Chattopadhyay -Mathematical Physics, Wiley Eastern Limited, 1990.

Unit I : Sections 4.2 to 4.5
Unit II : Sections 5.1 to 5.5
Unit III : Sections 5.6 to 5.9
Unit IV : Sections 6.1 to 6.4
Unit V : Sections 6.5. to 6.8.

REFERENCE(S)

[1] B.D. Gupta, Mathematical Physics, Vikas Publishing House Pvt Ltd, New Delhi, 1993.
[2] Goyal AK Ghatak, Mathematical Physics- Differential Equations and Transform Theory, McMillan India Ltd, 1995.
[3] E.Kreyzig, Advanced Engineering Mathematics ,John wiley and sons,1993.

ANALYTIC NUMBER THEORY

UNIT I

The fundamental theorem of arithmetic – Arithmetic function and Dirichlet multiplication

UNIT II

Averages of Arithmetic functions

UNIT III

Some elementary theorems on the distributions of prime numbers.

UNIT IV

Congruences

UNIT V

Quadratic residues and the quadratic reciprocity law

TEXT BOOK(S)

[1] Tom M. Apostol- Introduction to Analytic Number Theory, Narosa Publishing House, New Delhi,1990.

UNIT I Chapter 1 and Chapter 2
UNIT II Chapter 3
UNIT III Chapter 4
UNIT IV Chapter 5
UNIT V Chapter 9 - Sections 9.1 to 9.9

REFERENCE(S)

[1] J.P. Serre, A course in Arithmetic, GTM, Vol. 7, Springer-Verlag, 1973.

FUZZY SETS AND THEIR APPLICATIONS

UNIT I:

Fundamental Notions:

UNIT II :

Fuzzy Graphs:

UNIT III :

Fuzzy Relations:

UNIT IV :

Fuzzy Logic:

UNIT V :

The Laws -of Fuzzy Composition:

TEXT BOOK(S)

A. Kaufman, Introduction to the theory of Fuzzy subsets, Vol.1, Academic Press, New York, 1975.

UNIT I	Chapter I: Sections 1 to 8
UNIT II	Chapter II: Sections 10 to 18
UNIT III	Chapter II: Sections 19 to 29
UNIT IV	Chapter III: Sections 31 to 36 , 39 to 40
UNIT V	Chapter IV: Sec.43 to 49

REFERENCE(S)

1. H.J.Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers, Chennai, 1996.
2. George J.Klir and B. Yuan, Fuzzy sets and Fuzzy Logic-Theory and Applications, Prentice Hall of India, New Delhi, 2001.

INTERNET PROGRAMMING AND JAVA

UNIT – I

An overview of Java – Java Language fundamentals – Class and objects – Constructors – Garbage collection – The finalize method – method overloading – Recursion – this, static and final usage – Nested and Inner classes – Arrays – Inheritance – Methods overriding – abstract methods and abstract classes - final methods and final classes.

UNIT – II

Packages – Interfaces – Exception Handling – String Handling – Object class – Exploring Java.lang package.

UNIT – III

Util packages – Multithreading – Thread priorities – Inter Thread communications – Synchronization – Dead locks.

UNIT – IV

I/O Streams: Byte Stream Class – Character stream class – Serialization – JDBC – Data Manipulation.

UNIT – V

AWT : AWT controls, layout managers – Event Handling – Applet: Applet architecture – HTML applet tag – passing parameters to applet Java Beans.

TEXT BOOKS

[1] Herbert Schildt, Java 2 Complete Reference, Tata McGraw Hill, Fourth Edition, 2001.

[2] Ivan Bayross, Java 2.0 (Web Enabled Commercial Application Development) – BPB Publications India, Edition 2000. (Chapters 11,13,14 and 16 only)

REFERENCES

[1] Peter Norton & William Stach, “Guide to Java Programming”, First edition, 1997, Techmedia Publications, New Delhi.

[2] Lay S. Hortsmann, Gray Cornell, Core Hava 1 & 2 – fundamentals, 2nd Edition, 2000.

[3] Scott daks & Henry, Java threads, 2nd Edition, Shroff Publishers & distributors Pvt Limited.

MATHEMATICAL STATISTICS

UNIT I

SAMPLE MOMENTS AND THEIR FUNCTIONS: Notion of a sample and a statistic - Distribution functions of χ^2, s^2 and (χ^2, s^2) - χ^2 distribution - Student t-distribution - Fisher's Z-distribution - Snedecor's F-distribution - Distribution of sample mean from non-normal populations.

UNIT II

SIGNIFICANCE TEST: Concept of a statistical test - Parametric tests for small samples and large samples - c2 test Kolmogorov Theorem 10.11.1 - Smirnov Theorem 10.11.2 - Tests of Kolmogorov and Smirnov type - The Wald-Wolfovitz and Wilcoxon-Mann-Whitney tests - Independence Tests by contingency tables.

UNIT III

ESTIMATION: Preliminary notion - Consistency estimation - Unbiased estimates - Sufficiency - Efficiency - Asymptotically most efficient estimates - methods of finding estimates - confidence Interval.

UNIT IV

ANALYSIS OF VARIANCE: One way classification and two-way classification. Hypotheses Testing Poser functions - OC function- Most Powerful test - Uniformly most powerful test - unbiased test.

UNIT V

SEQUENTIAL ANALYSIS: SPRT - Auxiliary Theorem - Wald's fundamental identity - OC function and SPRT - E(n) and Determination of A and B - Testing a hypothesis, concerning p on 0-1 distribution and m in Normal distribution.

TEXT BOOK(S)

[1] M. Fisz, Probability Theory and Mathematical Statistics, John Wiley and sons, New York, 1963.

UNIT I Chapter 9 : Sections 9.1 to 9.8
UNIT II Chapter 10 : Sections 10.11, Chapters 11,12 Sections : 12.1 to 12.7.
UNIT III Chapter 13 : Sections 13.1 to 13.8 (Omit Section 13.9)
UNIT IV Chapter 15 : Sections 15.1 and 15.2 (Omit Section 15.3)
Chapter 16 : Sections 16.1 to 16.5 (Omit Section 16.6 and 16.7)
UNIT V Chapter 17 : Sections 17.1 to 17.9 (Omit Section 17.10)

REFERENCE(S)

1. E.J.Dudewicz and S.N.Mishra, Modern Mathematical Statistics, Jobn Wiley and Sons, New York, 1988.
2. V.K.Rohatgi An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Ltd., New Delhi, 1988(3rd Print).
3. G.G.Roussas, A First Course in Mathematical Statistics, Addison Wesley Publishing Company, 1973
4. B.L.Vander Waerden, Mathematical Statistics, G.Allen & Unwin Ltd., London, 1968.
5. J.P. Romano and A.F. Siegel, Counter examples in Probability and Statistics, Wadsworth and Brooks / Cole Advanced Books and Software, California, 1968.

STOCHASTIC PROCESSES

UNIT I

Stochastic Processes: Some notions – Specification of Stochastic processes – Stationary processes – Markov Chains – Definitions and examples – Higher Transition probabilities – Generalization of Independent Bernoulli trails – Sequence of chain – Dependent trains.

UNIT II

Markov chains : Classification of states and chains – determination of Higher transition probabilities – stability of a Markov system – Reducible chains – Markov chains with continuous state space.

UNIT III

Markov processes with Discrete state space : Poisson processes and their extensions – Poisson process and related distribution – Generalization of Poisson process- Birth and Death process – Markov processes with discrete state space (continuous time Markov Chains).

UNIT IV

Renewal processes and theory : Renewal process – Renewal processes in continuous time – Renewal equation – stopping time – Wald's equation – Renewal theorems.

UNIT V

Stochastic processes in Queuing – Queuing system – General concepts – the queuing model M/M/1 – Steady state Behaviour – transient behaviour of M/M/1 Model – Non-Markovian models - the model GI/M/1.

TEXT BOOK(S)

[1] J. Medhi, Stochastic Processes

UNIT I Ch. II :Sec 2.1 to 2.3, Ch III : Sec 3.1 to 3.3
UNIT II Ch III – Sec 3.4 tp 3.6, 3.8, 3.9 and 3.11
UNIT III Ch IV : Sec 4.1 to 4.5
UNIT IV Ch VI : Sec 6.1 to 6.5
UNIT V Ch X : Sec 10.1 to 10.3, 10.7 and 10.8 (omit sec 10.2.3 & 10.2.3.1)

REFERENCE(S)

1. Samuel Korlin, Howard M. Taylor, A first course in stochastic processes, II Edn.
2. Narayan Bhat , Elements of Applied Stochastic Processes,
3. Srinivasan and Metha, Stochastic Processes,
4. N.V. Prabhu, Stochastic Processes. Macmillan (NY)

INTEGRAL EQUATIONS, CALCULUS OF VARIATIONS AND FOURIER TRANSFORM

UNIT I

Calculus of variations – Variational Problems with Fixed Boundaries - Moving Boundaries- Sufficient condition for an Extremum.

UNIT – II

Conditional Extremum - Direct methods in Variational Problems

UNIT – III

Fourier transform: - Fourier sine and cosine transforms - Properties ,Convolution - Solving integral equations - Finite Fourier transform - Finite Fourier sine and cosine transforms - Fourier integral theorem - Parseval's identity.

Hankel Transform **:** Definition – Inverse formula –Linearity property – Hankel Transform of the derivatives of the function – Hankel Transform of differential operators.

UNIT IV

Linear Integral Equations - Definition, Regularity conditions – special kind of kernels – eigen values and eigen functions – convolution Integral – the inner and scalar product of two functions – Notation – reduction to a system of Algebraic equations – examples – Fredholm alternative - examples – an approximate method.

UNIT V

Method of successive approximations: Iterative scheme – examples – Volterra Integral equation – examples – some results about the resolvent kernel. Classical Fredholm Theory: the method of solution of Fredholm – Fredholm's first theorem – second theorem – third theorem.

TEXT BOOK(S)

[1] Ram.P.Kanwal – Linear Integral Equations Theory and Practise, Academic Press 1971.

[2] L. Elsgolts, Differential equations and the calculus of variations, Mir publishers, Moscow 1970.

[3] A.R. Vasishtha, R.K. Gupta, Integral Transforms, Krishna Prakashan Media Pvt Ltd, India, 2002.

UNIT – I - Chapter 6,7,8 of [2]
UNIT – II - Chapter 9,10 of [2]
UNIT – III - Chapters 7,9 of [3]
UNIT – IV - Chapters 1 and 2 of [1]
UNIT – V - Chapters 3 and 4 of [1]

REFERENCE(S)

[1] S.J. Mikhlin, Linear Integral Equations (translated from Russian), Hindustan Book Agency, 1960.

[2] I.N. Snedden, Mixed Boundary Value Problems in Potential Theory, North Holland, 1966.

DISCRETE DYNAMICAL SYSTEMS

UNIT – I

Phase Portraits, Periodic Points and Stable Sets, Hyperbolic, Attracting and Repelling Periodic Points, Bifurcation, Topological Conjugacy.

UNIT – II

The Logistic Function, Cantor Sets and Chaos, Period-Doubling Cascade - Symbolic Dynamics.

UNIT - III

Complex Dynamics, Quadratic Family, Julia Sets, Mandelbrot Set.

UNIT – IV

Fractals.

UNIT – V

Theory of Chaotic Dynamical systems.

TEXT BOOKS:

[1] Richard M. Holmgren, A First Course in Discrete Dynamical Systems, Springer Verlag (1996).

[2] Saber, N. Elaydi, Discrete Chaos, CRC press, 1999.

Unit I Chapter 4,5,6,7 from [1]
Unit II Chapter 8,10,11 from [1]
Unit III Chapter 7 from [3]
Unit IV Chapter 6 from [3]
Unit V Chapter 3 from [3]

Reference:

[1] R.L. Devaney, Introduction to Chaotic Dynamical Systems 2 edn, Addison Wesely Ltd.

RELATIONAL DATA BASE MANAGEMENT SYSTEMS

UNIT I :

Introduction: Data base system verses file system – View of data – Data Models – Database Languages – Database uses and Administrators – database system structure.

Entity Relationship Model: Basic concepts – Constraints-Keys – Design Issues – ER Diagram – Weak entity sets – Design of an ER Database schema – Reduction of an ER schema to tables.

Relational Model: Structure – Relational Algebra – Extended Relational Algebra – Algebraic Operations – Modification – Tuple Relational Calculus – Domain Relational Calculus.

UNIT II:

SQL: Structure set operations –Aggregate functions - Null values – Nested sub queries – Views – Complex queries – Joined Relations – Embedded SQL –Dynamic SQL – QBE – Domain Constraints – Differential Integrity – Assertions – Triggers.

UNIT III

Database Design: Relational – First Normal form – Functional Dependencies – Decomposition – Boyce-codd normal form – Third normal form – Fourth normal form – More normal form .(C.J.Date)*.

Storage and file structure: Overview fo physical storage media – File organization of records – Indexind and Hasing – Basic Concepts – B^+ Tree - B Tree Index files – Static and Dynamic Hashing.

UNIT IV

Transactions concepts: Transaction state – concurrent execution – Serializability – Recoverability – Testing for Serializability.

Concurrent control: Lock based protocols – Timestamp based Protocols – Validation based Protocols – Deadlock Handling.

Recovery System: Failure Classification – Recovery and Atomically – Log bases recovery.

UNIT V

Database System Architecture: Centralized and Client Server Architecture – Server System Architecture – Parallel System – Distributed Systems Network Types.

Distributed Database: Distributed data storage - Distributed Transactions – Commit Protocols - Distributed Query Processing.

TEXT BOOKS

1. Henry F.Korth and Abraham Silberschatz, " Database System Concepts", 4th Edition McGraw Hill 2002.
2. *C.J.Date, " An introduction to Database System", 7th Edition, Addison Wesly 2000.(Sections 10.2,10.3,11.3,11.5,12.2,12.3,12.4,12.7)

REFERENCES

1. Bepin. C. Desai, " An Introduction to Data Base System", Galogotia Publications Private Limited.
2. Ivan Bayross, "SQL and PL/SQL", PBP Publications.

EXTRA DISCIPLINARY PAPERS
C PROGRAMMING AND NUMERICAL METHODS & PRACTICALS

UNIT I

Overview of C – Constants, Variables and Data Types – Operators and Expression

UNIT II

Managing I/O Operators – Decision Making and Branching

UNIT III

Decision Making and Looping – Arrays

UNIT IV

User-Defined functions – Structures and Unions

UNIT V

Pointers – File Management

LIST OF PRACTICALS

1. Fixed point iteration
2. Newton-Raphson method
3. Lagrange interpolation
4. Newton's forward and backward difference formula
5. Gauss elimination method
6. Gauss-Seidel method
7. Trapezoidal rule
8. Simpson's 1/3 rule
9. Euler's method
10. Runge-Kutta method for second and fourth order
11. Standard deviation
12. Correlation coefficient
13. Straight line fit by method of least squares.

TEXT BOOK(S)

E. Balagurusamy, Programming in ANSI C Second Ed., TMH, New Delhi, 1989.

UNIT – I -Chapters 1, 2 and 3
UNIT – II -Chapters 4 and 5
UNIT – III -Chapters 6 and 7
UNIT – IV -Chapters 9 and 10
UNIT – V -Chapters 11 and 12

REFERENCE(S)

[1] Peter A. Darnel and Philip E. Margolis, C : Software Engineering Approach, Narosa Publishing House (Springer International Student Edition, 1993)

[2] Samuel P. Harkisonand Gly L. Steele Jr., C: A Reference Manual, 2nd Edn. Prentice Hall of India, 1984.

[3] Brain W. Kernighan and Dennis M. Ritchie, A C Program Language, 2nd Edition (ANSI Features), Prentice Hall, 1989.

FUZZY MATHEMATICS

UNIT – I

Fuzzy sets – Basic types – Basic concepts – α-cuts – Additional properties of α-cuts – Extension principle for Fuzzy sets.

UNIT – II

Operations on Fuzzy sets – Types of operations – Fuzzy complements – t-Norms – Fuzzy Unions – Combinations of operations.

UNIT – III

Fuzzy Arithmetic – Fuzzy numbers – Arithmetic operations on intervals – Arithmetic operations on Fuzzy numbers.

UNIT – IV

Fuzzy relations – Binary fuzzy relations – Fuzzy equivalence relations – Fuzzy compatibility relations – Fuzzy ordering relations – Fuzzy morphisms.

UNIT - V

Fuzzy Relation Equations – General discussion – Problem partitioning – Solution method – Fuzzy Relation Equations based on Sup-i Compositions - Fuzzy Relation Equations based on inf-ω_i Compositions.

TEXT BOOK

[1] **George J.Klir and B. Yuan**, Fuzzy Sets and Fuzzy Logic, Prentice Hall of India, New Delhi, 2004.

Unit I Chapter 1 and 2

Unit II Chapter 3

Unit III Chapter 4

Unit IV Chapter 5

Unit V Chapter 6

REFERENCE(S)

[1] H.J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers Limited, New Delhi, 1991.

MATHEMATICAL MODELLING

UNIT I

Mathematical Modelling through Ordinary Differential Equations of First order : Linear Growth and Decay Models – Non-Linear Growth and Decay Models – Compartment Models – Dynamics problems – Geometrical problems.

UNIT II

Mathematical Modelling through Systems of Ordinary Differential Equations of First Order : Population Dynamics – Epidemics – Compartment Models – Economics – Medicine, Arms Race, Battles and International Trade – Dynamics.

UNIT III

Mathematical Modelling through Ordinary Differential Equations of Second Order: Planetary Motions – Circular Motion and Motion of Satellites – Mathematical Modelling through Linear Differential Equations of Second Order – Miscellaneous Mathematical Models.

UNIT IV

Mathematical Modelling through Difference Equations : Simple Models – Basic Theory of Linear Difference Equations with Constant Coefficients – Economics and Finance – Population Dynamics and Genetics – Probability Theory.

UNIT V

Mathematical Modelling through Graphs : Solutions which can be Modelled through Graphs – Mathematical Modelling in Terms of Directed Graphs, Signed Graphs, Weighted Digraphs and Unoriented Graphs.

TEXT BOOK(S)

J.N. Kapur, Mathematical Modelling, Wiley Eastern Limited, New Delhi, 1988.

REFERENCE(S)

[1] J. N. Kapur, Mathematical Models in Biology and Medicine, Affiliated East –West Press Pvt Limited, New Delhi, 1981.

STATISTICS

UNIT I

Collection, classification and tabulation of data, graphical and diagramatic representation – Bar diagrams, Pie diagram, Histogram, Frequency polygon, frequency curve and Ogives.

UNIT II

Measures of central tendency – Mean, Median and Mode in series of individual observations, Discrete series, Continuous series (inclusive), More than frequency, Less than frequency, Mid-value and open-end class.

UNIT III

Measures of dispersion – Range, Quartile deviation, Mean deviation about an average, Standard deviation and co-efficient of variation for individual, discrete and continuous type data.

UNIT IV

Correlation – Different types of correlation – Positive, Negative, Simple, Partial Multiple, Linear and non-Linear correlation. Methods of correlation – Karlpearson's Spearman's correlations and Concurrent deviation .

UNIT V

Regression types and method of analysis, Regression line, Regression equations, Deviation taken from arithmetic mean of X and Y, Deviation taken from assumed mean, Partial and multiple regression coefficients – Applications

TEXT BOOK(S)

[1] S.C.Gupta, V.K.Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi, 1994.

REFERENCE(S)

[1] Freund J.E.(2001); Mathematical Statistics, Prentice Hall of India.
[2] Goon, A.M., Gupta M.K., Dos Gupta, B, (1991), Fundamentals of Statistics, Vol.I, World Press, Calcutta.