சென்னைப் பல்கலைக்கழகம்

தொலைதூரக் கல்வி நிறுவனம்

M.Sc. Degree Course in

MATHEMATICS

கணிதம்

Non-Semester

(Effective from the Academic Year 2005 - 2006)

UNIVERSITY OF MADRAS

INSTITUTE OF DISTANCE EDUCATION

CHENNAI - 600 005

M.Sc. MATHEMATICS

SCHEME OF EXAMINATIONS

FIRST YEAR

Paper	Subjects	Duration Hours	Max. Marks
I	Algebra	3	100
II	Real Analysis	3	100
III	Differential Equations	3	100
IV	Probability Theory and Mathematical Statistics	3	100
V	**Elective-I** **Computer Oriented Paper**		
	Programming with C++ and Numerical Methods	3	100
	Theory : Maximum 60 marks		
	Practical Maximum 40 marks		
	SECOND YEAR		
VI	Complex Analysis	3	100
VII	Mechanics	3	100
VIII	Topology and Functional Analysis	3	100
IX	Differential Geometry and Tensor Analysis	3	100
X	**Elective-II** **Computer Oriented Paper**		
	Java Programming	3	100
	Theory : Maximum 60 marks		
	Practical Maximum 40 marks		

INSTITUTE OF DISTANCE EDUCATION

M.Sc. DEGREE COURSE IN MATHEMATICS

SYLLABUS

FIRST YEAR

Paper I - ALGEBRA

Unit - I

Another counting principle - class equation for finite groups and its applications - Sylow's theorems (For theorem 2.12.1, First proof only).- Solvable groups - Direct products - Finite abelian groups- Modules

Chapter 2 : Sections 2.11 and 2.12 (Omit Lemma 2.12.5), 2.13 and 2.14 (Theorem 2.14.1 only)

Chapter 4 : Section 4.5

Chapter 5 : Section 5.7 (Lemma 5.7.1, Lemma 5.7.2, Theorem 5.7.1)

Unit - II

Linear Transformations: Canonical forms –Triangular form - Nilpotent transformations. Jordan form - rational canonical form.

Chapter 6 : Sections 6.4 , 6.5, 6.6 and 6.7

Unit - III

Trace and transpose - Hermitian, unitary, normal transformations, real quadratic form - Extension fields – Transcendence of e.

Chapter 5: Section 5.1 and 5.2

Chapter 6 : Sections 6.8, 6.10 and 6.11 (Omit 6.9)

Unit - IV

Roots or Polynomials.- More about roots - Elements of Galois theory.

Chapter 5: Sections 5.3, 5.5 and 5.6

Unit - V

Finite fields - Wedderburn's theorem on finite division rings- Solvability by radicals - A theorem of Frobenius - Integral Quaternions and the Four - Square theorem.

Chapter 5: Section 5.7 (omit Lemma 5.7.1, Lemma 5.7.2 and Theorem 5.7.1)

Chapter 7: Sections 7.1 , 7.2 (Theorem 7.2.1 only), 7.3 and 7.4

Content and Treatment as in :

I.N. Herstein. *Topics in Algebra* (II Edition) Wiley Eastern Limited, New Delhi, 1975.

Books for Supplementary Reading and Reference

1. M.Artin, *Algebra,* Prentice Hall of India, 1991.
2. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, *Basic Abstract Algebra* (II Edition) Cambridge University Press, 1997. (Indian Edition)

3. I.S.Luther and I.B.S.Passi, *Algebra,* Vol. I – Groups(1996); Vol. II Rings, Narosa Publishing House, New Delhi, 1999

4. D.S.Malik, J.N. Mordeson and M.K.Sen, *Fundamental of Abstract Algebra*, McGraw Hill (International Edition), New York. 1997.

5. N.Jacobson, *Basic Algebra,* Vol. I & II W.H.Freeman (1980); also published by Hindustan Publishing Company, New Delhi.

Paper II - REAL ANALYSIS

Unit - I : FUNCTIONS OF BOUNDED VARIATION

Introduction - Properties of monotonic functions - Functions of bounded variation - Total variation - Additive property of total variation - Total variation on [a, x] as a function of x - Functions of bounded variation expressed as the difference of two increasing functions - Continuous functions of bounded variation.

Infinite Series : Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series.

The Riemann - Stieltjes Integral - Introduction - Notation - The definition of the Riemann - Stieltjes integral - Linear Properties - Integration by parts- Change of variable in a Riemann - Stieltjes integral - Reduction to a Riemann Integral – Euler's summation formula - Monotonically increasing integrators, Upper and lower integrals - Additive and linearity properties of upper and lower integrals - Riemann's condition - Comparison theorems.

Chapter - 6 : Sections 6.1 to 6.8 (Apostol)

Chapter - 7 : Sections 7.1 to 7.14(Apostol)

Chapter -8 : Sections 8.8, 8.15, 8.17, 8.18(Apostol)

Unit - II

The Riemann-Stieltjes Integral - Integrators of bounded variation-Sufficient conditions for the existence of Riemann-Stieltjes integrals-Necessary conditions for the existence of Riemann-Stieltjes integrals- Mean value theorems for Riemann - Stieltjes integrals - The integrals as a function of the interval - Second fundamental theorem of integral calculus-Change of variable in a Riemann integral-Second Mean Value Theorem for Riemann integral-Riemann-Stieltjes integrals depending on a parameter-Differentiation under the integral sign-Lebesgue criteriaon for the existence of Riemann integrals.

Infinite Series and infinite Products - Double sequences - Double series - Rearrangement theorem for double series - A sufficient condition for equality of iterated series - Multiplication of series - Cesaro summability - Infinite products.

Chapter - 8 : Sections 8.20, 8.21 to 8.26

Power series - Multiplication of power series - The Taylor's series generated by a function - Bernstein's theorem - Abel's limit theorem - Tauber's theorem

Chapter - 7 : Sections 7.18 to 7.26(Apostol)

Chapter 9 : Sections 9.14 9.15, 9.19, 9.20, 9.22, 9.23(Apostol)

Unit - III

Sequences of Functions -Pointwise convergence of sequences of functions - Examples of sequences of real - valued functions - Definition of uniform convergence - Uniform convergence and continuity - The Cauchy condition for uniform convergence - Uniform convergence of infinite series of functions - Uniform convergence and Riemann - Stieltjes integration - Uniform convergence and differentiation - Sufficient condition for uniform convergence of a series - Mean convergence.

Fourier Series and Fourier Integrals - Introduction - Orthogonal system of functions - The theorem on best approximation - The Fourier series of a function relative to an orthonormal system - Properties of Fourier Coefficients - The Riesz-Fischer Thorem - The convergence and representation problems in for trigonometric series - The Riemann - Lebesgue Lemma - The Dirichlet Integrals - An integral representation for the partial sums of Fourier series - Riemann's localization theorem - Sufficient conditions for convergence of a Fourier series at a particular point - Cesaro summability of Fourier series- Consequences of Fejes's theorem - The Weierstrass approximation theorem

Chapter -9 : Sections 9.1 to 9.6, 9.8, 9.10,9.11, 9.13(Apostol)

Chapter-11 : Sections 11.1 to 11.15 (Apostol)

Unit - IV

Measure on the Real line - Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability

Integration of Functions of a Real variable - Integration of Non- negative functions - The General Integral - Riemann and Lebesgue Integrals

Chapter - 2 Sec 2.1 to 2.5 (de Barra)

Chapter - 3 Sec 3.1,3.2 and 3.4 (de Barra)

Unit - V

Multivariable Differential Calculus - Introduction - The Directional derivative - Directional derivative and continuity - The total derivative - The total derivative expressed in terms of partial derivatives - The matrix of linear function - The Jacobian matrix - The chain rule - Matrix form of chain rule - The mean - value theorem for differentiable functions - A sufficient condition for differentiability - A sufficient condition for equality of mixed partial derivatives - Taylor's theorem for functions of R_n to R_1

Implicit Functions and Extremum Problems

Functions with non-zero Jacobian determinants – The inverse function theorem-The Implicit function theorem-Extrema of real valued functions of severable variables-Extremum problems with side conditions.

Chapter 12 : Section 12.1 to 12.14 (Apostol)

Chapter 13 : Sections 13.1 to 13.7 (Apostol)

Contents and Treatment as in :

Tom M.Apostol : *Mathematical Analysis*, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974. (UNITS –I, II, III and V)

G. de Barra, *Measure Theory and Integration*, Wiley Eastern Ltd., New Delhi, 1981. (for UNIT IV)

Books for Supplementary Reading and Reference

1. Bartle, R.G. *Real Analysis*, John Wiley and Sons Inc., 1976.
2. Rudin,W. *Principles of Mathematical Analysis*, 3rd Edition. McGraw Hill Company, New York, 1976.
3. Malik,S.C. and Savita Arora. *Mathematical Analysis*, Wiley Eastern Limited.New Delhi, 1991.
4. Sanjay Arora and Bansi Lal, *Introduction to Real Analysis*, Satya Prakashan, New Delhi, 1991.
5. Gelbaum, B.R. and J. Olmsted, Counter Examples in Analysis, Holden day, San Francisco, 1964.
6. Burkill,J.C. *The Lebesgue Integral*, Cambridge University Press, 1951.
7. Munroe,M.E. *Measure and Integration*. Addison-Wesley, Mass.1971.
8. Roydon,H.L.*Real Analysis*, Macmillan Publishing Company, New York,1988.
9. Rudin, W. *Principles of Mathematical Analysis*, McGraw Hill Company, New York,1979.

Paper III - DIFFERENTIAL EQUATIONS

Unit - I : LINEAR EQUATIONS WITH CONSTANT COEFFICIENTS

Second order homogeneous equations-Initial value problems-Linear dependence and independence-Wronskian and a formula for Wronskian-Non-homogeneous equation of order two.

Linear equations with constant coefficients

Homogeneous and non-homogeneous equation of order n –Initial value problems- Annihilator method to solve non-homogeneous equation- Algebra of constant coefficient operators.

Chapter 2: Sections 1 to 6 (Coddington)

Chapter 2 : Sections 7 to 12. (Coddington)

Unit- II : LINEAR EQUATION WITH VARIABLE COEFFICIENTS

Initial value problems -Existence and uniqueness theorems – Solutions to solve a non-homogeneous equation – Wronskian and linear dependence – reduction of the order of a homogeneous equation – homogeneous equation with analytic coefficients-The Legendre equation.

Linear equation with regular singular points

Euler equation – Second order equations with regular singular points –Exceptional cases – Bessel Function.

Chapter 3 : Sections 1 to 8 (Omit section 9) (Coddington)

Chapter 4 : Sections 1 to 4 and 6 to 8 (Omit sections 5 and 9) (Coddington)

Unit - III : Existence and uniqueness of solutions to first order equations

Equation with variable separated – Exact equation – method of successive approximations – the Lipschitz condition – convergence of the successive approximations and the existence theorem.

Mathematical Models and Classification of second order equation

Classical equations-Vibrating string – Vibrating membrane – waves in elastic medium – Conduction of heat in solids – Gravitational potential – Second order equations in two independent variables – canonical forms – equations with constant coefficients – general solution

Chapter 5	:	Sections 1 to 6 (Omit Sections 7 to 9) (Coddington)
Chapter 2	:	Sections 2.1 to 2.6 (Tyn Myint-U and Lokenath Debnath)
Chapter 3	:	Sections 3.1 to 3.4 (Omit 3.5) (Tyn Myint-U and Lokenath Debnath)

Unit - IV : CAUCHY PROBLEM

The Cauchy problem – Cauchy-Kowalewsky theorem – Homogeneous wave equation – Initial Boundary value problem- Non-homogeneous boundary conditions – Finite string with fixed ends – Non-homogeneous wave equation – Riemann method – Goursat problem – spherical wave equation – cylindrical wave equation.

Method of separation of variables

Separation of variable- Vibrating string problem – Existence and uniqueness of solution of vibrating string problem.- Heat conduction problem – Existence and uniqueness of solution of heat conduction problem – Laplace and beam equations

Chapter 4	:	Sections 4.1 to 4.11(Tyn Myint-U and Lokenath Debnath)
Chapter 6	:	Sections 6.1 to 6.6 (Omit section 6.7) (Tyn Myint-U and Lokenath Debnath)

Unit - V : Boundary Value Problems

Boundary value problems – Maximum and minimum principles – Uniqueness and continuity theorem – Dirichlet Problem for a circle , a circular annulus, a rectangle – Dirichlet problem involving Poisson equation – Neumann problem for a circle and a rectangle.

Green's Function

The Delta function – Green's function – Method of Green's function – Dirichlet Problem for the Laplace and Helmholtz operators – Method of images and eigen functions – Higher dimensional problem – Neumann Problem.

Chapter 8 : Sections 8.1 to 8.9(Tyn Myint-U and Lokenath Debnath)

Chapter 10 : Section 10.1 to 10.9 (Tyn Myint-U and Lokenath Debnath)

Content and Treatment as in :

E.A.Coddington, *A introduction to ordinary differential equations* (3rd Printing) Prentice-Hall of India Ltd.,New Delhi, 1987.

Tyn Myint-U and Lokenath Debnath, *Partial Differential Equations for Scientists and Engineers* (Third Edition), North Hollan, New York, 1987.

Books for Supplementary Reading and Reference

1. Williams E. Boyce and Richard C. DI Prima, *Elementary differential equations and boundary value problems*,John Wiley and sons, New York, 1967.
2. George F Simmons, *Differential equations with applications and historical notes,* Tata McGraw Hill, New Delhi, 1974.

3. N.N. Lebedev, *Special functions and their applications*, Prentice Hall of India, New Delhi, 1965.

4. W.T. Reid. *Ordinary Differential Equations*, John Wiley and Sons, New York, 1971

5. P.Hartman, *Ordinary Differential Equations,* John Wiley and Sons, New York, 1964.

6. M.D.Raisinghania, *Advanced Differential Equations*, S.Chand & Company Ltd. New Delhi 2001

7. B.Rai, D.P.Choudary and H.I. Freedman, *A Course in Ordinary Differential Equations,* Narosa Publishing House, New Delhi, 2002.

8. M.M.Smirnov, *Second order partial differential equations*, Leningrad, 1964.

9. Ian Sneddon, *Elements of partial differential equations*, McGraw Hill, New Delhi, 1983.

10. R. Dennemeyer, *Introduction to Partial Differential Equations and Boundary Value Problems ,* McGraw Hill Book Company, New York, 1968.

Paper IV - PROBABILITY THEORY AND MATHEMATICAL STATISTICS

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.

PARAMETERS OF THE DISTRIBUTION

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

Chapter 1: Sections 1.1 to 1.7

Chapter 2 : Sections 2.1 to 2.9

Chapter 3 : Sections 3.1 to 3.8

Unit - II : 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.

SOME PROBABILITY DISTRIBUTIONS

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

Chapter 4 : Sections 4.1 to 4.7

Chapter 5 : Section 5.1 to 5.10 (Omit Section 5.11)

Unit - III : 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.

SAMPLE MOMENTS AND THEIR FUNCTIONS

Notion of a sample and a statistic – Distribution functions of $\bar{X}$, S^2 and ($\bar{X}$, S^2) - χ^2 distribution – Student t-distribution – Fisher's Z-distribution – Snedecor's F-distribution – Distribution of sample mean from non-normal populations

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)

Chapter 9 : Sections 9.1 to 9.8

Unit - IV : SIGNIFICANCE TEST

Concept of a statistical test – Parametric tests for small samples and large samples - χ^2 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.

ESTIMATION

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

Chapter 10 : Section 10.11

Chapter 11 : 12.1 to 12.7.

Chapter 13 : Sections 13.1 to 13.8 (Omit Section 13.9)

Unit - V : 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.

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.

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)

Chapter 17 : Sections 17.1 to 17.9 (Omit Section 17.10)

Contents and treatment as in :

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

Books for Supplementary Reading and Reference

1. V.K.Rohatgi *An Introduction to Probability Theory and Mathematical Statistics*, Wiley Eastern Ltd., New Delhi, 1988(3rd Print).
2. S.I.Resnick, *A Probability Path*, Birhauser, Berlin,1999.
3. B.R.Bhat , *Modern Probability Theory* (3rd Edition), New Age International (P)Ltd, New Delhi, 1999
4. E.J.Dudewicz and S.N.Mishra , *Modern Mathematical Statistics*, John Wiley and Sons, New York, 1988.
5. G.G.Roussas, *A First Course in Mathematical Statistics,* Addison Wesley Publishing Company, 1973

6. B.L.Vander Waerden, *Mathematical Statistics,* G.Allen & Unwin Ltd., London, 1968.

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

PAPER V - ELECTIVE - I

5.2. PROGRAMMING IN C++ AND NUMERICAL METHODS

(Theory 60 marks + Computer Laboratory 40 marks)

Unit - I

Principles of OOP-Tokens-Expressions, Control Structures-Functions-Classes and Objects-constructors and destructors Chapter 1 to 6

Unit - II

Operator Overloading and type Conversions-Inheritance-Pointers, Virtual Functions and Polymorphism-Managing Console I/O Operations-Working with Files Chapter 7 to 11

Unit - III

The solution of Nonlinear Equations f(x)=0
Chapter2: Sec. 2.1 to 2.7

The Solution of linear Systems AX=B
Chapter3: Sec. 3.3 to 3.7 (omit Sec. 3.1 & 3.2)

Unit - IV

Interpolation and Polynomial Approximation
Chapter 4: 4.1 to 4.4 (omit Sec. 4.5 & 4.6)

Numerical Differentiation
Chapter6: Sec. 6.1 & 6.2

Unit - V

Numerical Integration

Chapter 7: Sec. 7.1 to 7.5

Numerical Optimization

Chapter 8: Sec.8.1

Solution of Differential Equations

Chapter 9: Sec. 9.1 to 9.6 (omit 9.7 to 9.9)

Contents and Treatment as in:

For Units I and II:

E.Balagurusamy, *Object Oriented Programming with C++,* Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1999

For Units III, IV and V :

John H.Mathews*, Numerical Methods for Mathematics, Science and Engineering* (2nd Edn.), Prentice Hall, New Delhi, 2000

Books for supplementary reading and Reference:

1. S.B.Lipman and J.Lajoi, *C++ primer*, Addison Wesley, Massachussets

2. C.F.Gerald and P.O.Wheatley, *Applied Numerical Analysis* (5th Edn.), Addison Wesley (Indian Edition), 1998

Computer Laboratory-I Practice Exercises : (40 marks) (Laboratory University Examination : 30 marks and Record : 10 Marks)

Section I (15 Marks)

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

4. Write a program to include all possible binary operator overloading using friend function.

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

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

7. 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.

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

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

10. 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 Newton-Raphson Method
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
4. Numerical Solution to Differential Equations
   - 4.1 Euler's Method
   - 4.2 Runge-Kutta Method of order 4
5. Numerical Differentiation and Integration
   - 5.1 First and Second Derivatives
   - 5.2 Trapezoidal and Simpson's 1/3-Rule

SECOND YEAR

PAPER VI - COMPLEX ANALYSIS

Unit - I : CAUCHY'S INTEGRAL FORMULA

The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives.

Local Properties of analytical Functions :

Removable Singularities-Taylors's Theorem – Zeros and poles – The local Mapping – The Maximum Principle .

The general form of Cauchy's Theorem

Chains and cycles- Simple Continuity - Homology - The General statement of Cauchy's Theorem - Proof of Cauchy's theorem - Locally exact differentials- Multilply connected regions - Residue theorem - The argument principle.

Chapter 4 : Section 2 : 2.1 to 2.3

Chapter 4 : Section 3 : 3.1 to 3.4

Chapter 4 : Section 4 : 4.1 to 4.7

Chapter 4 : Section 5 : 5.1 and 5.2

Unit - II : Evaluation of Definite Integrals and Harmonic Functions

Evaluation of definite integrals - Definition of Harmonic function and basic properties - Mean value property - Poisson formula.

Harmonic Functions and Power Series Expansions

Schwarz theorem - The reflection principle - Weierstrass theorem – Taylor's Series – Laurent series .

Chapter 4 : Section 5 : 5.3

Chapter 4 : Sections 6 : 6.1 to 6.3

Chapter 4 : Sections 6.4 and 6.5

Chapter 5 : Sections 1.1 to 1.3

Unit - III : PARTIAL FRACTIONS AND ENTIRE FUNCTIONS

Partial fractions - Infinite products – Canonical products – Gamma Function- Jensen's formula – Hadamard's Theorem

Riemann Theta Function and Normal Families

Product development – Extension of ζ(s) to the whole plane – The zeros of zeta function – Equicontinuity – Normality and compactness – Arzela's theorem – Families of analytic functions – The Classcial Definition

Chapter 5 : Sections 2.1 to 2.4

Chapter 5 : Sections 3.1 and 3.2

Chapter 5 : Sections 4.1 to 4.4

Chapter 5 : Sections 5.1 to 5.5

Unit - IV

Riemann mapping Theorem : Statement and Proof – Boundary Behaviour – Use of the Reflection Principle.

Conformal mappings of polygons : Behaviour at an angle – Schwarz-Christoffel formula – Mapping on a rectangle.

Harmonic Functions : Functions with mean value property – Harnack's principle.

Elliptic functions : Simply periodic functions – Doubly periodic functions

Chapter 6 : Sections 1.1 to 1.3 (Omit Section1.4)

Chapter 6 : Sections 2.1 to 2.3 (Omit section 2.4)

Chapter 6 : Section 3.1 and 3.2

Chapter 7 : Sections 1.1 to 1.3

Chapter 7 : Sections 2.1 to 2.4

Unit - V

Weierstrass Theory : The Weierstrass Ã-function – The functions z(s) and s(s) – The differential equation – The modular equation l(t) – The Conformal mapping by l(t).

Analytic Continuation : The Weiertrass Theory – Germs and Sheaves – Sections and Riemann surfaces – Analytic continuation along Arcs – Homotopic curves – The Monodromy Theorem – Branch points.

Chapter 7 : Sections 3.1 to 3.5

Chapter 8 : Sections 1.1 to 1.7

Contents and Treatment as in :

Lars V. Ahlfors, *Complex Analysis*, (3rd edition) McGraw Hill Co., New York, 1979

Books for Supplementary Reading and Reference

1. H.A. Presfly, *Introduction to complex Analysis*, Clarendon Press, oxford, 1990.
2. J.B. Conway, *Functions of one complex variables* Springer - Verlag, International student Edition, Narosa Publishing Co.
3. E. Hille, *Analytic function Theory* (2 vols.), Gonm & Co, 1959.
4. M.Heins, *Complex function Theory*, Academic Press, New York,1968.

PAPER VII - MECHANICS

Unit - I : MECHANICAL SYSTEMS

The Mechanical system- Generalised coordinates – Constraints - Virtual work - Energy and Momentum

Chapter 1 : Sections 1.1 to 1.5

Unit - II : LAGRANGE'S EQUATIONS

Derivation of Lagrange's equations- Examples- Integrals of motion.

Chapter 2 : Sections 2.1 to 2.4

Unit - III : HAMILTON'S EQUATIONS

Hamilton's Principle - Hamilton's Equation - Other variational principle.

Hamilton-Jacobi Theory

Hamilton Principle function – Hamilton-Jacobi Equation - Separability

Chapter 4 : Sections 4.1 to 4.3 (Omit section 4.4)

Chapter 5 : Sections 5.1 to 5.3

Unit - IV : CANONICAL TRANSFORMATION

Differential forms and generating functions – Special Transformations– Lagrange and Poisson brackets.

Chapter 6 : Sections 6.1, 6.2 ,6.3 and 6.4 (Omit sections 6.5 and 6.6)

Unit - V : 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.

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.

Accelarated Systems : Rocket with constant accelaration – example – Rocket with constant thrust

Chapter 7 : Sections 7.1 , 7.2, 7.3 and 7.4

Contents and Treatment as in :

D. Greenwood, *Classical Dynamics*, Prentice Hall of India, New Delhi, 1985.

Books for Supplementary Reading and Reference

1. H. Goldstein, *Classical Mechanics,* (2nd Edition) Narosa Publishing House, New Delhi.

2. N.C.Rane and P.S.C.Joag, *Classical Mechanics*, Tata McGraw Hill, 1991.

3. J.L.Synge and B.A.Griffth, *Principles of Mechanics* (3rd Edition) McGraw Hill Book Co., New York, 1970.

4. A.S.Eddington. *The Mathematical Theory of Relativity*, Cambridge University Press, 1930.

5. P.G.Bergman, *An Introduction to Theory of Relativity*, New York, 1942

PAPER VIII - TOPOLOGY AND FUNCTIONAL ANALYSIS

Unit - I : METRIC SPACES

Convergence, completeness and Baire's Theorem; Continuous mappings;Spaces of continuous functions; Euclidean and Unitary spaces.

Topological Spaces

The definition and some Examples; Elementary concepts- Open bases and subbases; Weak topologies; the function algebras C(X,R) and C(X,C)

Chapter 2 : Sections 12 to 15

Chapter 3 : Sections 16 to 20

Unit - II : COMPACT SPACES

Tychonoff's theorem and locally compact spaces; Compactness for metric spaces; Ascoli's theorem.

T_1 – spaces and Hausdorff spaces; Completely regular spaces and normal spaces; Urysohn's lemma and the Tietze extension theorem; The Urysohn imbedding theorem.

Chapter 4 : Sections 21 to 25

Chapter 5 : Sections 26 to 29

Unit - III

The Stone – Cech compactification; Connected spaces; The components of a space; Totally disconnected spaces; Locally connected spaces; The Weierstrass approximation Theorem.

Banach Spaces

Definition – Some examples – Continuous Linear Transformations – The Hahn-Banach Theorem – The natural embedding of N in N**

Chapter 5: Section 30

Chapter 6 : Sections 31 to 34

Chapter 7 : Section 35

Chapter 9: Sections 46 to 49

Unit - IV : BANACH SPACES AND HILBERT SPACES

Open mapping theorem – conjugate of an operator – Definition and some simple properties – Orthogonal complements – Orthonormal sets

Hilbert Space

Conjugate space H* - Adjoint of an operator – Self-adjoint operator – Normal and Unitary Operators – Projections

Chapter 9 : Sections 50 and 51

Chapter 10 : Sections 52, 53 and 54.

Chapter 10 : Sections 55, 56,57,58 and 59.

Unit - V : PRELIMINARIES ON BANACH ALGEBRAS

Definition and some examples – Regular and single elements – Topological divisors of zero – spectrum – the formula for the spectral radius – the radical and semi-simplicity.

Structure of commutative Banach Algebras

Gelfand mapping – Applications of the formula $r(x) = \lim \| x^n \|^{1/n}$ - Involutions in Banach Algebras – Gelfand-Neumark Theorem.

Chapter 12 : Sections 64 to 69.

Chapter 13 : Sections 70 to 73.

Contents and treatment as in :

G.F.Simmons , *Introduction to topology and Modern Analysis*, McGraw Hill International Book Company, New York, 1963.

Books for Supplementary Reading and Reference

1. James R. Munkres, *Topology* (2nd Edition) Pearson Education Pvt. Ltd., Delhi-2002 (Third Indian Reprint)
2. J. Dugundji , *Topology* , Prentice Hall of India, New Delhi, 1975.
3. J.L. Kelly, *General Topology*, Van Nostrand, Reinhold Co., New York
4. S.Willard, *General Topology*, Addison - Wesley, Mass., 1970
5. W. Rudin, *Functional Analysis,* Tata McGraw-Hill Publishing Company, New Delhi , 1973
6. G. Bachman & L.Narici, *Functional Analysis* Academic Press, New York ,1966.
7. H.C. Goffman and G.Fedrick, *First course in functional Analysis,* Prentice Hall of India, New Delhi, 1987.
8. E. Kreyszig, *Introductory Functional Analysis with Applications,* John wiley & Sons, New York.,1978.

PAPER IX - DIFFERENTIAL GEOMETRY AND TENSOR ANALYSIS

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.

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.

Chapter I : Sections 1 to 9.

Chapter II: Sections 1 to 9.

Unit - II : GEODESICS

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

Non Intrinsic properties of a surface

The second fundamental form- Principle curvature – Lines of curvature – Developable - Developable associated with space curves and with curves on surface - Minimal surfaces – Ruled surfaces.

Chapter II: Sections 10 to 18.

Chapter III: Sections 1 to 8.

Unit - III : 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.

Tensor Theory

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.

Chapter IV : Sections 1 to 8 (Omit 9 to 15).

Chapter 2 : Sections 18 to 26 (L.S.Sokolnikoff)

Unit - IV

Symmetric and skew symmetric tensors – Relative tensors- Metric Tensor – The fundamental and associated tensors – Christoffel's symbols – Transformations of Chrisffel's symbols- Covariant Differentiation of Tensors – Formulas for covariant Differentiation-

Chapter 2 : Sections 27 to 34 (L.S.Sokolnikoff)

Unit - V

Ricci Theorem – Riemann –Christoffel Tensor and their properties- Einstein Tensor – Riemannian and Euclidean Spaces (Existence Theorem) – The e-systems and the generalized Kronecker deltas – Application of the e-systems.

Chapter 2 : Section 35 to 41(L.S.Sokolnikoff)

Contents and Treatment as in :

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

I.S.Sokolinikoff, *Tensor Analysis*, (2nd Edition) John Wiley & Sons, Inc, New York, 1964

Books for Supplementary Reading and Reference

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. Wilhelm 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.
5. J.L.Synge and A.Schild, *Tensor Calculus*, Toronto, 1949.

PAPER X - ELECTIVE- II

10.1 JAVA PROGRAMMING

(Theory 60 Marks + Computer Laboratory 40 Marks)

Unit - I

Java Tokens – Java statements – Constants – Variables – Data types.

Chapters 3 and 4

Unit - II

Operators – Expressions – Decision making and Branching.

Chapters 5,6 and 7

Unit - III

Classes – Objects – Methods – Arrays – Strings – Vectors – Multiple Inheritance.

Chapters 8, 9 and 10

Unit - IV

Multithreaded Programming – Managing errors and Exceptions.

Chapters 12 and 13

Unit - V

Applet Programming.

Chapter 14

Contents and Treatment as in :

E. Balagurusamy, *Programming with Java – A primer* , Tata McGraw Hill Publishing Company Limited, New Delhi, 1998.

Books for Supplementary Reading and Reference :

1. Genn Vanderburg, *Tricks of the Java Programming,* Sams Net, Indianapolis, 1996.
2. Sulelman “Sam” Lalni and Kris Jamsa, *Java*, Galgotia, 1998.
3. Steven Holzner, *Java Programming,* BPB Publications, New Delhi, 1996.

Computer Laboratory-II Practice Exercises
(Laboratory University Examination : 30 Marks and Record : 10 Marks)

Section 1. CLASSES, OBJECTS, INHERITANCE, INTERFACE

1. Design a class to represent a Bank Account.Include the following members:

Data Members :	Methods :
1) Name of the Depositor	1) To Assign initial values.
2) Account Number	2) To deposit an amount.
3) Type of account	3) To withdraw an amount after checking the balance.
4) Balance	4) To display the name and balance.

   Write a Java program for handling 10 customers.

2. Create a class called Publication. Create class Tape and class Book from Publication. Describe properties for subclasses. Create an array of publication references to hold combination of books and tapes.

Section 2: EXCEPTION HANDLING, MULTITHREADING AND PACKAGES

3. Write a Java program to handle different types of exceptions using try, catch and finally statements
4. Write a Java program to implement the behavior of threads.

(a) To create and run threads.

(b) To suspend and stop threads.

(c) To move a thread from one state to another.

(d) By assigning a priority for each thread.

5. Create two Threads subclasses, one with sun() that starts up, captures the handle of the second Thread object and then calls wait(). The other class run() should call notifyall() for the first Thread after some number of seconds have passed, so that the first thread after some seconds have passed, so the first thread after some number of seconds have passed, so that the first thread can print out a message.

Section 3: APPLET PROGRAMMING

6. Write an applet to draw the following shapes :

   a) Cone b)Cylinder c)Cube d) Square inside a circle e)Circle inside a square.

7. Design applet to display bar chart for the following table which shows the annual turnover of XYZ company during the period 1997 to 2000.

Year	:	1997	1998	1999	2000
Turnover (in Crore)	:	110	150	100	180

Section 4 : AWT FORMS DESIGN USING FRAMES

8. Create a frame with two text fields and three buttons (Cut, Copy & Paste). Data entered in the first text field should response, according to the buttons clicked.

9. Create a frame that contains 3 text fields and four buttons for basic arithmetic operations. You have to enter two numbers in first two text fields. On clicking the respective button that answer should be displayed in the last text filed.

10. A car company called Maruthi is selling four models of cars. They are shown below :

CODE	CAR MODEL	PRICE
800	Maruthi 800	Rs 2.14 Lakh
1000	Maruthi 1000	Rs 3.72 Lakh
Esteem	Maruthi Esteem	Rs 3.69 Lakh
Zen	Maruthi Zen	Rs 3.91 Lakh

Design a frame with 4 buttons called 800, 1000, Esteem, Zen. When we click a button the details of a particular model must appeared in an exclusive background color, text color and font.