SRI SANKARA ARTS AND SCIENCE COLLEGE
AUTONOMOUS
CHOICE BASED CREDIT SYSTEM (CBCS)
M.Sc Mathematics
(Effective from the academic year 2019 – 2020)

M.Sc Mathematics

S.No	Study Components	M.Sc.,		
		Number of papers	**Credits per paper**	**Total Credits**
1	Core Papers	15	4	60
2	Elective Papers	5	3	15
3	Extra Disciplinary Papers	2	3	6
4	Internship	1	2	2
5	Soft Skills	4	2	8
			Total	91

Effective from the academic year 2019-2020
M.Sc Mathematics
Scheme of Examination

I Semester

Course Components/ Title of the Paper	Credits	Ins Hours	CIA	EXT	Total
Core Paper I Algebra-I	4	6	25	75	100
Core Paper II Mathematical Analysis	4	6	25	75	100
Core Paper III Ordinary Differential Equations	4	6	25	75	100
Core Paper IV Graph Theory	4	6	25	75	100
Elective Paper-I Choose one from Group -A	3	3	25	75	100
Soft Skill Paper-I	2	1	40	60	100

GROUP - A

1. Automata Theory
2. Advance Discrete Mathematics
3. Number Theory

II Semester

Course Components/ Title of the Paper	Credits	Ins Hours	CIA	EXT	Total
Core Paper V Algebra-II	4	5	25	75	100
Core Paper VI Measure Theory and Integration	4	5	25	75	100
Core Paper VII Partial Differential Equations	4	5	25	75	100
Core Paper VIII Probability Theory	4	5	25	75	100
Elective Paper-II Choose one from Group -B	3	5	25	75	100
Extra Disciplinary Paper-I Choose one paper from Group C	3	5			
Soft Skill-II	2	1	40	60	100
Internship	2	-	-	-	-

GROUP - B

1. Fuzzy Theory
2. Wavelets
3. Advanced Mathematical Programming

GROUP-C

1. C++
2. Financial Mathematics
3. Mathematical Economics

III Semester

Course Components/ Title of the Paper	Credits	Ins Hours	CIA	EXT	Total
Core Paper IX Complex Analysis-I	4	6	25	75	100
Core Paper X Topology	4	6	25	75	100
Core Paper XI Operations Research	4	6	25	75	100
Elective Paper-III Choose one paper from Group D	3	5	25	75	100
Extra Disciplinary Paper-I Choose one paper from Group E	3	5	25	75	100
Soft Skill-III	2	2	40	60	100

GROUP - D

1. Calculus of Variation and Integral Equation
2. Optimization Techniques

GROUP - E

1. Java Programming
2. Data structure and Algorithms

IV Semester

Course Components/ Title of the Paper	Credits	Ins Hours	CIA	EXT	Total
Core Paper XII Complex Analysis-II	4	5	25	75	100
Core Paper XIII Functional Analysis	4	5	25	75	100
Core Paper XIV Differential Geometry	4	5	25	75	100
Core Paper XV Mechanics	4	5	25	75	100
Elective Paper-IV Choose one paper from Group F	3	4	25	75	100
Elective Paper-IV Choose one paper from Group G	3	4	25	75	100
Soft Skill-IV	2	2	40	60	100

GROUP - F

1. Design and Analysis of Algorithms
2. Fluid Dynamics

GROUP - G

1. Tensor Analysis and relativity theory
2. Stochastic Process

CORE PAPER- I
ALGEBRA-I

To introduce the concept and to develop knowledge on Algebraic Structures like Ring, Field, vector space and modules

UNIT I
Group actions on a set, Sylow theorems - Applications of Sylow theorems.
Chapter 2: Section 2.12

UNIT II
Direct products - Finite abelian groups- Modules
Chapter 2: Sections 2.13 and 2.14 Chapter 4: Section 4.5

UNIT III
Linear Transformations - Canonical forms -Triangular form – Nilpotent transformations.
Chapter 6: Sections 6.4 , 6.5

UNIT IV
Jordan form - rational canonical form.
Chapter 6:Sections 6.6 and 6.7

UNIT V
Trace and transpose - Hermitian, unitary, normal transformations, real quadratic form.
Chapter 6 : Sections 6.8, 6.10 and 6.11 (Omit 6.9)

Recommended Text:
I.N. Herstein. Topics in Algebra (II Edition) Wiley, 2002.

Reference Book
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. D. S. Dummit and R. M. Foote, Abstract Algebra, 2nd edition, Wiley, 2002.
4. I. S. Luther and I. B. S. Passi, Algebra, Vol. I - Groups(1996); Vol. II Rings, (1999)
Narosa Publishing House , New Delhi.
5. N. Jacobson, Basic Algebra, Vol. I & II Hindustan Publishing Company,
New Delhi.

CORE PAPER-II
MATHEMATICAL ANALYSIS-I

To give the students a thorough knowledge of the various
aspects of Real line and the Lebesgue theory. This course give the knowledge for any advanced learning in Pure Mathematics.

Unit I
Basic Topology: Metric spaces-Compact sets - Perfect sets - Connected sets.
Chapter-2:Pages 30-43

Unit II
Continuity: Limits of functions - continuous functions - continuity and compactness.
Chapter-4:Pages 83-93

Unit III
Continuity: continuity and connectedness - discontinuities - monotonic functions - infinite limits and limits at infinity.
Chapter-4:Pages 93-98

Unit IV
Differentiation: Mean Value theorems - The Continuity of the derivatives - L' Hospitals rules - Derivatives of higher order - Taylor's theorem.
Chapter-5:Pages 107-111

Unit V
The Lebesgue Theory: Set functions - construction of the Lebesgue measure - Measure spaces - Measurable functions.
Chapter-11:Pages 300-313

Recommended Text Book
Principles of Mathematical Analysis, Walter Rudin, Third Edition, McGraw Hill Education (2013)(India) Private Limited

Reference Book
1. Tom Apostal, Mathematical Analysis, Addison – Wesley Publishing Company, London 1971.
2. Richard R.Goldberg, Methods of Real Analysis, Oxford & IBH Publishing Company(Last reprint),2017.
3. H.L.Roydan, Real Analysis, Pearson Education (Singapore) Pvt. Ltd. Third Edition, (Reprint)
4. Malik. S. C, and SavitaArora. Mathematical Analysis, Wiley Eastern
Limited. New Delhi, 1991.

CORE PAPER- III
ORDINARY DIFFERENTIAL EQUATIONS

To develop strong background on finding solutions to linear differential equations with constant and variable coefficients and also with singular points, to study existence and uniqueness of the solutions of first order 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.
Chapter 2: Sections 1 to 6

UNIT-II :

Linear equations with constant coefficients: Homogeneous and non-homogeneous equation of order n –Initial value problems-Annihilator method to solve non-homogeneous equation.
Chapter 2 : Sections 7 to 11.

UNIT-III :

Linear equations with variable coefficient: 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.
Chapter : 3 Sections 1 to 8 (omit section 9)

UNIT-IV :

Linear equation with regular singular points Second order equations with regular singular points –Exceptional cases – Bessel equation .
Chapter 4 : Sections 3, 4 and 6 to 8 (omit sections 5 and 9)

UNIT-V :

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.
Chapter 5 : Sections 1 to 6 (omit Sections 7 to 9)

Recommended Text

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

Reference Book

1. George F Simmons, Differential equations with applications and historical notes, Tata McGraw Hill, New Delhi, 1974.
2. M. D.Raisinghania, Advanced Differential Equations, S.Chand& Company Ltd. New Delhi,2001
3. S.G. Deo, Lakshmikantham, V. Raghavendra, Textbook of Ordinary Differential Equations, Second Edition, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 1997.

CORE PAPER- IV
GRAPH THEORY

To study the concepts of graphs, subgraphs, connected graphs, Hamilton cycles, coloring of graphs, independent sets, cliques, vertex coloring, and colouring of maps

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 ana Bonds – Cut Vertices.
Chapter 1:Section 1.1 – 1.7
Chapter 2:Section 2.1 – 2.3

UNIT-II

Connectivity, Euler tours and Hamilton Cycles : Connectivity – Blocks – Euler tours – Hamilton Cycles.
Chapter 3:Section 3.1 – 3.2
Chapter 4:Section 4.1 – 4.2

UNIT-III

Matchings, Edge Colourings : Matchings – Matchings and Coverings in Bipartite Graphs – Edge Chromatic Number – Vizing's Theorem.
Chapter 5:Section 5.1 – 5.2
Chapter 6:Section 6.1 – 6.2

UNIT-IV

Independent sets and Cliques, Vertex Colourings : Independent sets – Ramsey's Theorem – Chromatic Number – Brooks' Theorem – Chromatic Polynomials.
Chapter 7:Section 7.1 – 7.2
Chapter 8:Section 8.1 – 8.2, 8.4

UNIT-V
Planar graphs : Plane and planar Graphs – Dual graphs – Euler's Formula – The Five- Colour Theorem and the Four-Colour Conjecture.
Chapter 9:Section 9.1 – 9.3, 9.6

Recommended Text
J.A.Bondy and U.S.R. Murthy , Graph Theory and Applications , Macmillan, London, 1976.

Reference Book
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. Balakrishnan, K. Ranganathan, A Textbook of Graph Theory, Springer International Edition, New Delhi, 2008.

CORE PAPER V
ALGEBRA – II

To teach the concept of Ring theory and fields
After the completion of the course the student will be able to problems about ring and fields

UNIT - I

Extension fields - Transcendence of e.
Chapter 5: Section 5.1 and 5.2

UNIT – II

Roots or Polynomials.- More about roots
Chapter 5: Sections 5.3 and 5.5

UNIT – III

Elements of Galois Theory.
Chapter 5: Section 5.6

UNIT – IV

Finite fields - Wedderburn's theorem on finite division rings
Chapter 7: Sections 7.1 and 7.2 (Theorem 7.2.1 only)

UNIT – V

Galois groups over the Rationals -– A theorem of Frobenius.
Chapter 5: Sections 5.8
Chapter 7: Sections 7.3

Recommended text book:
I.N. Herstein. Topics in Algebra (II Edition) Wiley 2002.

Reference Book
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. D. S. Dummit and R. M. Foote, Abstract Algebra, 2nd edition, Wiley, 2002.

CORE PAPER VI
MEASURE THEORY AND INTEGRATION

To teach the concept of measure set and functions
After the completion of the course the student will be able to solve the Lebesgue integrals problems.

Unit-I

Measurable Sets: Length of sets - Outer Measure - Lebesgue Measure - Properties of Measurable sets,
Chapter 3:Section 3.1-3.4

Unit-II

Measurable Sets: Borel sets and their Measurability - further properties of Measurable sets - Characterisations of Measurable sets
Chapter 3: Section 3.5-3.7

Unit-III

Measurable Sets: Non Measurable sets. Measurable functions: Definition - properties of Measurable functions - step functions - operations on Measurable functions.
Chapter 3: Section 3.8
Chapter 4: Section 4.1- 4.4

Unit-IV

Measurable Functions: Characteristic function - simple function - Continuous function - sets of Measure zero.
Chapter 4:Section 4.5-4.8

Unit-V

Lebesgue Integral: Riemann Integral - Lebesgue Integral of a Bounded function - Comparison of Riemann Integral and Lebesgue Integral - Properties of the Lebesgue integral for bounded Measurable functions.
Chapter 5:Section 5.1-5.4

Recommended text
Lebesgue Measure and Integration P.K.Jain, V.P Gupta, Pankaj Jain New Age International Publishers, 2nd Edition 2011.

Reference Book
1. G. de Barra, Measure Theory and Integration, New Age International,2003
2. H.L. Royden, Real Analysis, Third Edition, Prentice Hall of India, New Delhi, 2007.
3. Walter Rudin, Real and Complex Analysis, Mc-Graw Hill Book Company, New York, 1970.

CORE PAPER VII
PARTIAL DIFFERENTIAL EQUATIONS

To teach the concept of Riemann methods
After the completion of the course the student will be able to solve the partial differential equations.

UNIT-I

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 3: Sections 3.1- 3.6,
Chapter 4: Sections 4.1 - 4.4

UNIT-II

Cauchy Problem : The Cauchy problem – Cauchy-Kowalewsky theorem – Homogeneous wave equation – Initial Boundary value problem- Non-homogeneous boundary conditions – Finite string with fixed ends.
Chapter 5: Sections 5.1 - 5.6

UNIT-III

Cauchy Problem: Non-homogeneous wave equation – Riemann method – Goursat problem – spherical wave equation – cylindrical wave equation.
Chapter 5: Sections 5.7 - 5.11

UNIT-IV

Method of separation of variables: Separation of variable- Vibrating string problem – Existence and uniqueness of solution of vibrating string problem.
Chapter 7: Sections 7.1 - 7.4

UNIT-V

Method of separation of variables: Heat conduction problem – Existence and uniqueness of solution of heat conduction problem – Laplace and beam equations
Chapter 7: Sections 7.5 - 7.7

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

Reference Book
1. R.C Mc.Owen, Partial Differential Equations, 2nd edition Pearson Education. New Delhi,2005.
2. Ian.Sneddon, Elements of Partial Differential Equations, McGraw Hill, New Delhi, 1983.

CORE PAPER VIII
PROBABILITY THEORY

To teach the concept of probability and stochastic convergence
After the completion of the course the student will be able to solve the problem about Chebyshev.

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.
Chapter 1: Sections 1.1 - 1.7,
Chapter 2: Sections 2.1 - 2.9
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.
Chapter 3: Sections 3.1 - 3.8
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.
Chapter 4: Sections 4.1 - 4.7
UNIT-IV
Some Probability distributions: One point , two point , Binomial – Polya – Hyper geometric – Poisson (discrete) distributions – Uniform – normal gamma – Beta – Cauchy and Laplace (continuous) distributions.
Chapter 5: Section 5.1 - 5.10 (Omit Section 5.11)
UNIT-V
Limit Theorems: Stochastic convergence – Bernoulli law of large numbers – Convergence of sequence of distribution functions – Levy-Cramer Theorems
Chapter 6: Sections 6.1 - 6.6(Omit Sections 6.5)

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

Reference Book
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.

CORE PAPER -IX
COMPLEX ANALYSIS-I

To study metric space and elementary properties of analytic functions and familiar with the concept of complex integration so as to apply Cauchy's theorem.

Unit -I
Elementary point set topology:Sets and Elements – Metric spaces – connectedness – Compactness – Continuous function – Topological space.
Chapter 3: Section1. 1.1 – 1.6 (page no. 50 – 66)
Unit-II
Elementary Conformal Mappings:Conformality: Arcs and closed curve – Analytical function in regions – Conformal Mappings. Linear transformations: The linear group – the cross ratio – symmetry. The use of Level curves – A surveys of Elementary mappings – elementary Riemann surface.
Chapter 3: Section 2: 2.1 – 2.3 (page no. 67 -75)
Section 3: 3.1 – 3.3 (page no. 76 – 82)
Section 4: 4.1 – 4.3 (page no. 89 – 99).

Unit -III
Cauchy Integral formula:The index of a point with respect to a closed curve – the integral formula – higher derivatives. Local properties of analytic functions: removable singularities – Taylors theorem Zeros and poles – the local mapping – the maximum principle.
Chapter 4: Section 2: 2.1 – 2.3 (page no. 114 – 122)
Section 3: 3.1 – 3.4 (page no. 124 – 135).

Unit-IV
The general form of Cauchy's theorem:Chains and Cycles – Simple connectivity – Homotopy – The general statement of Cauchy's theorem - The proof of Cauchy's theorem – Multiply connected regions – Residue theorem – the Argument Principle.
Chapter 4: Section 4: 4.1 – 4.5 and 4.7 (omit4.6)
Section 5: 5.1 and 5.2 (page no. 137 – 154)
Unit-V
Evaluation of Definite Integrals and Harmonic functions:Evaluation of definite integrals – Definition of Harmonic functions and basic properties – Mean value property – Poisson formula.
Chapter 4: Section 5: 5.3 only
Section 6: 6.1 – 6.5 (page no. 154 – 172)

Recommended text book:
Lars V. Ahlfors, Complex Analysis,(3rd edition) McGraw Hill Co.,Newyork, 1979.

Reference book
1. H.A. Priestly, Introduction to Complex Analysis, Clarendon Press,Oxford, 2003.
2. T.W Gamelin, Complex Analysis, Springer International Edition, 2004.
3. S.Ponnusamy, Foundations of Complex Analysis, Second Edition, Narosa Publishing House, India, 2005.

CORE PAPER - X
TOPOLOGY

To develop analytical thinking and the study of Continuity, Connectivity, Connectedness, Compactness in Topological spaces and the separation axioms.

Unit - I

Topological spaces and Continuous Functions **:**Topological spaces – basic for a topology – the order topology – the product topology on $X \times Y$ – the subspace topology – closed sets and limit points – continuous functions – the product topology.
Chapter -2:Section 12-19 (Page Nos75 – 112)

Unit - II

Topological spaces and Continuous Functions **:**The metric topology – the quotient topology.
Chapter-2 Section 20-22(Page Nos 119 – 145)

Unit - III

Connectedness and Compactness :Connected space – connected subspaces of the real line – Components and local connectedness – Compact spaces.
Chapter-3:Section 23-26 (Page Nos 147 – 170)

Unit – IV

Connectedness and Compactness:Compact subspaces of the real line – limit point compactness – local compactness
Chapter-3:Section 27-29 (Page Nos 172 – 185)

Unit - V

Countability and Separation Axioms:The countability axioms – the separation axioms – Normal spaces – The Urysohn Lemma – The Urysohn metrization theorem – The Tietze extension theorem.
Chapter-4:Section 30-35 (Page Nos 189 – 222).

Recommended text book
Topology James R. Munkres Second Edition Pearson Education,Inc. and Dorling Kindersley publishing Inc.

Reference Book:
1. T. W. Gamelin and R.E. Greene, Introduction to Topology, The Saunders Series, 1983.
2. G. F. Simmons, Introduction to Topology and Modern Analysis, Mcgraw-Hill book company, 2001.

CORE PAPER-XI
OPERATIONS RESEARCH

To enlighten the students in the field of Operations Research which has many applications in management techniques.

Unit – I

Decision Theory:Introduction – steps of decision making process – types of decision making environments – decision making under uncertainty – decision making under risk – posterior probabilities and Bayesian analysis – decision trees analysis – decision making with utilities.

Chapter 11: Sec. 11.1-11.8 (Page Nos 339 – 376)

Unit - II

Project Management : PERT and CPM :Introduction – basic difference between PERT and CPM – phases of project management – PERT/CPM network components and precedence relationships – critical path analysis – project scheduling with uncertain activity times – project time cost trade off.

Chapter 13: Sec. 13.1 -13.7 (Page Nos 417 – 454)

Unit - III

Deterministic Inventory Control Models :Introduction – the meaning of inventory control – functional role of inventory – reasons for carrying inventory – Factors involved in inventory problem analysis – Inventory model building – Single item Inventory control models without shortages – Single item inventory models with shortages

Chapter 14: Sec. 14.1 -14.8 (Page Nos 474 – 500)

Unit - IV

Queues Theory **:**Introduction – The structure of a Queuing system – performance measures of a Queuing system – probability distributions in queuing system – Classification of Queuing models – Single server Queuing models – Multi-server Queuing models – Finite calling population Queuing models.

Chapter 16 : Sec. 16.1-16.8 (Page Nos 559 – 595)

Unit -V

Replacement and Maintenance Models:Introduction – Types of failure – Replacement of items whose efficiency deteriorates with time – Replacement of items that completely fail – Other replacement problems.

Chapter 16: Sec. 16.1-16.5 (Page Nos 613 – 643)

Contents and treatment as in

J.K.Sharma, Operations Research ,MacMillan India, New Delhi, 2001

Reference Book:

1. Hamdy A. Taha, Operations Research: An Introduction,Ninth Edition, Prentice Hall, New Delhi, 2011.
2. KantiSwarup, P.K. Gupta and Man Mohan, Operations Research, Eighth Edition, Sulltan Chand & Sons, New Delhi, 1997.

CORE PAPER XII
MECHANICS

To study mechanical systems under generalized coordinate systems, virtual work, energy and momentum, to study mechanics developed by Newton, Langrange, Hamilton Jacobi Theory.

UNIT-I

Mechanical systems:The Mechanical system - Generalised coordinates - Constraints - Virtual work - Energy and Momentum
Chapter 1 : Sections 1.1-1.5 (Page Nos 1 – 40)

UNIT-II

Lagrange's equations: Derivation of Lagrange's equations- Examples - Integrals of motion.
Chapter 2 : Sections 2.1-2.3 (Omit Section 2.4) (Page Nos 43 – 83)

UNIT-III

Hamilton's equations: Hamilton's Principle - Hamilton's Equation - Other variational principle.
Chapter 4 : Sections 4.1 - 4.3 (Omit section 4.4) (Page Nos 147 – 178)

UNIT-IV

Hamilton-jacobi theory:Hamilton Principle function - Hamilton-Jacobi Equation
Chapter 5 : Sections 5.1 -5.2 (omit – 5.3) (Page Nos 187 – 203)

UNIT-V

Canonical transformation:Differential forms and generating functions - Lagrange and Poisson brackets.
Chapter 6 : Sections 6.1 and 6.3 (omit sections 6.2 6.4, 6.5 and 6.6) (Page Nos 214 – 227 &241-248)

Recommended text book
D. T. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985.

Reference Books
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.

CORE PAPER XIII
COMPLEX ANALYSIS – II

To teach the concept of Riemann theta function and Normal families
After the completion of the course the student will be able to solve the Taylors series

UNIT- I
Power Series Expansion:Sequences – Series – Uniform Convergence – Power Series – Abel's Limit Theorem – Weierstrass 's Theorem – the Taylors Series – the Laurent Series.
Partial Fractions and Factorization: Partial Fractions – Infinite Products – Canonical Products – the Gamma Function.
Chapter 2: Section 2.1 -2.5, Chapter 5: Section 1.1 to 2.4

UNIT – II
Entire Function:Jensen's Formula – the Riemann Theta Function – Product Development – Extension of $\zeta(s)$ to the Whole Plane – the Functional Equations – Zero of the Zeta Function.
Chapter 5: Section 3.1,
Chapter 5: Section 4.1 - 4.4

UNIT – III
Normal Families:Equicontinuity – Normality and Compactness – Arzela's Theorem – Families of Analytic Funtions – the Classical Definition.
Chapter 5: Section 5.1 - 5.5

UNIT – IV
Riemann Mapping Theorem:Statement and Proof – Boundary Behaviour – Use of the Reflection Principle.
Conformal Mapping of Polygons: Behaviour at an Angle – Schwarz-C hristoffel Formula – Mapping on a Rectangle.
Chapter 6: Section 1.1 - 1.6,
Section 2.1 - 2.3

UNIT – V
Simply Periodic Function and Doubly Periodic Function:Representation by Exponentials – Fourier Development Functions of Finite Order – the Period Module – Unimodular Transformations – the Canonical basis – General Properties of Elliptic Functions.
Chapter 7: Section 1.1 - 1.3,
Section 2.1 - 2.4

Recommended text

Lars.F.Ahlfors, Complex Analysis (3rd Edition) McGraw Hill Book Company, New York 1979.

Reference book

1.H.A. Presfly, Introduction to Complex Analysis, Clarendon Press, Oxford, 1990.
2.J.B.Corway, Function of one complex variables, Springer – Verlag , International Student Edition, Narosa Publishing Co.
3.E.Hille, Analytic Function Theory(vol -2), Gonm & Co, 1959.

CORE PAPER XIV
FUNCTIONAL ANALYSIS

To teach the concept of Banach and Hilbert Spaces and to introduce Banach algebras.

Unit -I

Fundamentals of Normed Spaces: Normed spaces- Continuity of linear maps
Chapters 2:Section 5,6 (omit sections 6.8)

Unit-II

Fundamentals of Normed Spaces:Hahn-Banach Theorems- Banach Spaces.
Chapters 2:Section 7,8 (omit sections 7.11,7,.12, 8.4)

Unit -III

Bounded linear maps on Banach spaces: Uniform boundedness principle-Closed Graph and Open Mapping theorems-Bounded Inverse Theorem- Spectrum of a bounded operator.
Chapter 3:Section 9-12 (omit sections 9.4 to 9.7, 11.2, 11.4, 11.5, 12.6, 12.7)

Unit-IV

Spaces of Bounded linear functionals: Duals and Transposes- Weak and weak *convergence- Reflexivity.

Chapter 4:Section 13,15,16 (omit sections 13.7, 13.8, 14, 15.5 to 15.7, 16.5 to 16.9)

Unit -V

Geometry of Hilbert spaces :Inner Product Spaces- Orthonormal sets- Best approximation- Projection and Riesz Representaion theorems.

Chapter 6: section 21-24 (omit sections 23.2, 23.4, 23.6, 24.7, 24.8)

Recommended text book

B.V. Limaye, Functional Analysis,3rd edition New Age International pvt ltd.publishers , New Delhi 2017.

Reference books

1. J.B.Conway, A Course in functional analysis, Spring Verlag Kreyszig, Introductory Functional Analysis with Applications, Springer Verlag.
2. W. Rudin, Functional Analysis, Tata McGraw-Hill publishing company, New Delhi, 1973.

CORE PAPER XV
DIFFERENTIAL GEOMETRY

To teach the concept of surface and curves
After the completion of the course the student will be able to solve the problems about tangent.

UNIT- I
Theory of Space Curve:Definition of a space curve – arc length – tangent – normal and binormal – curvature and torsion – tangent surface, involutes and evolutes- intrinsic equations – fundamental existence theorem for space curves – helices.
Chapters 1: Section 1 - 9(except sec 6)

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.
Chapter 2: Section 1 - 9

UNIT- III
Geodesics: Geodesics – canonical geodesic equations – normal property of geodesics – existence theorems.
Chapters 2: Section 10 - 13

UNIT- IV
Geodesic Curvature: Geodesic curvature – gauss-bonnet theorem – Gaussian curvature – surface of constant curvature.
Chapter 2: Section 15 - 18

UNIT- V
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.
Chapter 3 – Sections 1- 6

Recommended text book
T.J.WILLMORE, An Introduction to Differential Geometry , Oxford University Press, (17^{th} Impression) New Delhi 2002(Indian Print).

Reference book

1. D.SOMASUNDARAM, Differential Geometry.
2. J.A. Thorpe Elementary Topics in Differential Geometry, under – graduate Text in Mathematics, Springer – Verlag 1979.
3. Struik, D. T . Lectures on classical Differen

ELECTIVE - I

Automata Theory

To make the students understand the nuances of the automata and grammar
To make them understand application of these techniques in computer
To student contest free grammar

Unit -I
Finite Automata and Regular expression
Book 1
Chapter 2 :Section 2.1-2.4
Unit -II
Context free Grammar
Book 1
Chapter 2 :Section 2.5,
Chapter 4 :Section 4.1-4.3,4.5,4.6
Unit -III
Push Down Automaton
Book 1
Chapter 5 :Section 5.2,5.3
Unit- IV
Finite Automata and Lexical Analysis
Book 2
Chapter 3 :Section3.1-3.8

Unit -V

Basic parsing Techniques
Book 2
Chapter 5 :Section 5.1-5.5

Recommended text book
Book1
1.Johsn E Hopcroft and Jeffrey d.Ullman Introduction to Automata Theory Languages and computations Narosa publishing House Chennai -2 .
Book2
2.A.V Aho and Jeffrey d.Ullman principles of complier design Narosa publishing House Chennai -2

Reference Book
1. A. Salomaa, Formal Languages, Academic Press, New York, 1973.
2. John C. Martin, Introduction to Languages and theory of Computations (2nd Edition) Tata-McGraw Hill Company Ltd., New Delhi, 1997

ELECTIVE - II

Advanced Discrete Mathematics

This course aims to explore the topics like lattices and their applications , finite fields, polynomials and coding theory.

Unit- I

Lattices
Chapter 1:Section 1,2 and 3

Unit -II

Applications of Lattices
Chapter 2:Section 1 and 2

Unit- III

Finite Fields
Chapter 3:Section 2

Unit -IV

Polynomials
Chapter 3:Section 3 and 4

Unit -V

Coding Theory
Chapter 4:Section 1and 2

Recommended text book

Rudolf Lidl and Gunter Pilz, Applied Abstract Algebra, Spinger-Verlag, New York, 1984

Reference book

1. A.Gill, Applied Algebra for Computer Science, Prentice Hall Inc., New Jersey.
2. J.L.Gersting, Mathematical Structures for Computer Science(3rd Edn.), Computer Science Press, New York.
3. S.Wiitala, Discrete Mathematics- A Unified Approach, McGraw Hill Book Co.

ELECTIVE: III
NUMBER THEORY AND CRYPTOGRAPHY

To teach the concept of public key and private key by using number theory
After the completion of the course the students will be able to break and create the secrets

UNIT-I

Elementary Number Theory – Time Estimates for doing arithmetic – divisibility and Euclidean algorithm – Congruences – Application to factoring.

UNIT-II

Introduction to Classical Crypto systems – Some simple crypto systems – Enciphering matrices DES

UNIT-III

Finite Fields and quadratic Residues – Reciprocity

UNIT-IV

Public Key Cryptography

UNIT-V

Primality , Factoring and Elliptic Curves

Recommended text book

Neal Koblitz, A Course in Number Theory and Cryptography, Springer-Verlag, New York,1987

Reference Books

1. Niven and Zuckermann, An Introduction to Theory of Numbers (Edn. 3), Wiley Eastern Ltd., New Delhi,1976
2. David M.Burton, Elementary Number Theory, WmC.Brown Publishers, Dubuque, Iowa,1989
3. K.Ireland and M.Rosen, A Classical Introduction to Modern Number Theory, Springer Verlag, 1972

ELECTIVE- IV
FUZZY THEORY

To teach the concept of Graphs and Relations
After the completion of the course the student will be able to solve the Fuzzy logic problems.

UNIT – I

Fundamental Notions
Chapter I: Section 1 - 8

UNIT – II

Fuzzy Graphs
Chapter II: Section 10 - 18

UNIT – III

Fuzzy Relations
Chapter II: Section 19 - 29

UNIT – IV

Fuzzy Logic
Chapter III: Section 31 - 40 (Omit Section 37,38,41)

UNIT – V

The Laws of Fuzzy Composition
Chapter IV: Section 43 - 49

Recommended text book

A.Kaufman, Introduction to the theory of fuzzy subsets, vol I, Academic press, New York, 1975.

Reference books

H.J.Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers, Chennai, 1996.
George J.Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic – Theory and Applications, Prentice Hall India, New Delhi, 2001.

ELECTIVE - V
WAVELETS

To introduce discrete Fourier Transform, Wavelets in R, Z, Z_n and connection with differential equations.

UNIT-I

The Discrete Fourier Transforms
Chapter 2: Section 2.1 - 2.3

UNIT-II

Wavelets on Z_n
Chapter 3: Sectiion3.1 - 3.3

UNIT-III

Wavelets on Z
Chapter 4: Section 4.1 - 4.7

UNIT-IV

Wavelets on R
Chapter 5: Section 5.1 - 5.5

UNIT-V

Wavelets and Differential Equations
Chapter 6:Section 6.1- 6.3

Recommended text book

Michael W.Frazier, An Introduction to Wavelets through Linear Algebra, Springer Verlag, Berlin, 1999

Reference Books

1.C.K.Chui, An Introduction to Wavelets, Academic Press, 1992
2.E.Hernandez and G.Weiss, A First Course in Wavelets, CRC Press, New York,1996
3. D.F.Walnut, Introduction to Wavelet Analysis, Birhauser, 2004.

ELECTIVE - VI
ADVANCED MATHEMATICAL PROGRAMMING

To teach the concept of NLPP and Integer Linear Programmings
After the completion of the course the student will be able to solve the ILP problems.

UNIT – I

Integer Linear Programming : Types of Integer Linear Programming Problems – Concept of Cutting Plane – Gomory's All Integer Cutting Plane Method – Gomory's Mixed Integer Cutting Plane Method- Branch and Bound Method
Chapter 7

UNIT – II

Dynamic Programming : Characteristics of Dynamic Programming Problem - Developing Optimal Decision Policy- Dynamic Programming under Certainty – DP approach to solve LPP
Chapter 22

UNIT – III

Non-linear Programming Methods : Examples of NLPP – General NLPP – Graphical Solution – Quadratic Programming .
Chapter 24: Sections 24.1 -24.4 (Omit Beale's method)

UNIT – IV

Linear Programming Problem – Simple problems. Parametric Linear Programming : Variation in the coefficients c_j, Variations in the Right hand side, b_i
Chapter 4 : Section 4.1-4.3
Chapter 29

UNIT – V

Goal Programming : Difference between LP and GP approach – Concept of Goal Programming – Goal Programming Model formulation – Graphical solution method of Goal Programming.
Chapter 8 : Section 8.1 - 8.5

Recommended text book
J.K.Sharma, Operations Research,(fourth edition) Macmillan, New Delhi, 2009.

Reference Book
1. Hamdy A. Taha, Operations Research: An Introduction,
Ninth Edition, Prentice Hall, New Delhi, 2011.
2. KantiSwarup, P.K. Gupta and Man Mohan, Operations
Research, Eighth Edition, Sulltan Chand & Sons, New Delhi, 1997.

ELECTIVE–VII
STOCHASTIC PROCESS

This course aims to introduce advanced topics in Markov process, Markov chains and Renewal theory.

UNIT-I

Markov Chains :Classification of General Stochastic Processes – Markov Chain – Examples – Transition Probability Matrix – Classifications of States – Recurrence – Examples of recurrent Markov Chains.

Chapter 1: Section 3 only

Chapter 2: Sections 1 - 6 (Omit section 7)

UNIT-II

Limit Theorems of Markov Chains: Discrete renewal equation and its proof – Absorption probabilities – criteria for recurrence – Queuing models – Random walk.

Chapter 3: Sections 1 -7

UNIT-III

Continuous Time Markov Chains: Poisson Process – Pure Birth Process – Birth and Death Process – Birth and Death process with absorbing states – Finite State Continuous time Markov Chains.

Chapter 1: Section 2 (Poisson Process)

Chapter 4: Sections 1,2 and 4 - 7 (Omit sections 3 and 8)

UNIT-IV

Renewal Processes: Definition and related concepts – Some special Renewal processes – Renewal equation and Elementary Renewal Theorem and its applications.

Chapter 5: Sections 1 to 6.

UNIT-V

Brownian Motion : Definition – Joint probabilities for Brownian Motion – Continuity of paths and the maximum variables – Variations and extensions – Computing some functionals of Brownian Motion by Martingale methods.

Chapter 1: Section 2 (Brownian Motion)

Chapter 6: Sections 1 to 5 and 7A only (Omit Sections 6, and 7B,C)

Recommended text book

S.Karlin and H.M.Taylor. A First Course in Stochastic Processes(2nd edition), Academic Press, New York, 1975.

Reference Book

1,J. Medhi, Stochastic Processes (2nd Edition), New Age International, 1992.
2. S. Karlin, A first course in Stochastic Processes, (2nd Edition), Academic Press, 1958.
3. U.N. Bhat, Elements of Applied Stochastic Prcesses, John Wiley Sons, 1972.

ELECTIVE –VIII
CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS

The aim of the course is to introduce to the students the concept of calculus of variation and its applications and second to introduce various types of integral equations and how to solve these equations.

Unit -I
The Method of Variations in Problems with Fixed Boundaries
Chapter 6 :Sections 1 - 7 (Elsgolts)
Unit -II

Vibrational Problems with Moving Boundaries and certain other problems and Sufficient conditions for an Extremum
Chapter 7 : Sections 1 - 4 (Elsgolts)
Chapter 8 : Sections 1- 3(Elsgolts)
Unit -III
Variational Problems Involving a conditional Extremum
Chapter 9 : Sections 1 - 3. (Elsgolts)
Unit IV
Integral Equations with Separable Kernels and Method of successive approximations
Chapter 1 : Sections 1.1 - 1.7 (Kanwal)
Chapter 2 : Sections 2.1 - 2.5 (Kanwal)
Chapter 3 : Sections 3.1 - 3.5 (Kanwal)
Unit- V

Classical Fredholm Theory , Symmetric Kernels and Singular Integral Equations
Chapter 4 : Sections 4.1 - 4.5 (Kanwal)
Chapter 7 : Sections 7.1 - 7.6 (Kanwal)
Chapter 8 : Sections 8.1 - 8.5 (Kanwal)

Recommended text book
For Units I, II and III: L. Elsgolts , Differential Equations and the Calculus of variations, Mir Publishers, Moscow, 1973 (2nd Edition)
For Units IV and V: Ram P.Kanwal,Linear Integral Equations, Academic Press, New York, 1971.

Reference Book
1. A. S. Gupta, Calculus of Variations with Applications, PHI, New Delhi, 2005. (for Units I and II)
2. Ram P. Kanwal, Linear Integral Equations, Theory and Techniques, Academic Press, New York, 1971. (for Units III, IV and V)
3. M. D. Raisinghania, Integral Equations and Boundary Value Problems, S. Chand & Co., New Delhi, 2007.
4. Sudir K. Pundir and Rimple Pundir, Integral Equations and Boundary Value Problems, Pragati Prakasam, Meerut. 2005.

ELECTIVE -IX
OPTIMIZATION TECHNIQUES

To understand the theory behind optimization techniques, Local theory of optimization, global theory of optimization. Kuhn-Tucker Theorem high light some of the applications of optimization techniques.

Unit -I

Local theory:Optimisation of functional - Gateaux and Frechet Differentials - Frechet derivatives - Extrema - Euler-Lagrange Equations - Problems with variable end points. (Sec 7.1-7.6 Pages 169-184)

Unit -II

Global theory:Convex and concave functionals - Conjugate convex, concave functionals - Dual optimization problems - Min-Max theorem of game theory.
(Sec 7.8, 7.10-7.13 Pages 190, 191, 195-208)

Unit- III

Local theory of constrained optimisation:Lagrange multiplier theorem - Inverse function theorem – Equality and Inequality constraints - Kuhn-Tucker theorem.
(Sec 9.1-9.4 Pages 239-253)

Unit -IV

Iterative methods of optimization:Methods of solving equations - Successive approximation - Newton's method - Descent methods - Steepest descent.
(Sec 10.1-10.5 Pages 271-289)

Unit -V

Conjugate direction methods:Conjugate gradient method - Methods for solving constrained problems - Projection method - The Primal-Dual method – Penalty Functions.
(Sec 10.8-10.11 Pages 294-307)

Recommended text book

1. David G. Luenberger, Optimization by Vector Space Methods, Wiley Professional Paperback series, 1997.

References

1. C. Nelson Dorny, A Vector Space Approach to Models and Optimization, Robert Krieger Publishing Co., 1986. Chander Mohan and Kusum Deep, Optimization
Techniques, New Age International, 2010

ELECTIVE - X
TENSOR ANALYSIS AND RELATIVITY THEORY

The course aims to introduce vector algebra and vector calculus and special relativity and relativistic kinematics, dynamics and accelerated systems.

UNIT-I
Tensor algebra: Systems of Different orders - Summation Convention - Kronecker Symbols - Transformation of coordinates in Sn - Invariants - Covariant and Contravariant vectors - Tensors of Second Order - Mixed Tensors - Zero Tensor - Tensor Field - Algebra of Tensors - Equality of Tensors - Symmetric and Skew –symmetric tensors - Outer multiplication, Contraction and Inner Multiplication - Quotient Law of Tensors - Reciprocal Tensor of Tensor - Relative Tensor - Cross Product of Vectors.
Chapter I : I.1 - I.3, I.7 and I.8
Chapter II : II.1 - II.19

UNIT-II
Tensor calculus: Riemannian Space - Christoffel Symbols and their properties
Chapter III: III.1 and III.2

UNIT-III
Tensor calculus (Contd . . .) Covariant Differentiation of Tensors - Riemann - Christoffel Curvature Tensor - Intrinsic Differentiation.
Chapter III: III.3 - III.5

UNIT-IV
Special theory of relativity :Galilean Transformation - Maxwell's equations - The ether Theory - The Principle of Relativity. Relativistic Kinematics : 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.
Chapter 7 : Sections 7.1 and 7.2

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
Chapter 7 : Sections 7.3 and 7.4

Recommended Texts
1. U.C. De, Absos Ali Shaikh and Joydeep Sengupta, Tensor Calculus, Narosa Publishing House, New Delhi, 2004. (For Units I,II and III)
2. D. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985. (Units IV andV)

Reference Books
1. J.L.Synge and A.Schild, Tensor Calculus, Toronto, 1949.

ELECTIVE - XI
DESIGN AND ANALYSIS OF ALGORITHMS

To teach the concept of data structures and algorithm
After the completion of the course the student will be able to know the program about binary tree

UNIT -I
Algorithms:Introduction- Algorithm - Algorithm specification: Pseudocode Conventions, Recursive algorithms - Performance analysis: Space Complexity, Time Complexity, Asymptotic Notation, Practical Complexities.
Sections: 1.1, 1.2, 1.3.1 to 1.3.4

UNIT -II
Data structures and Queues Arrays – ordered lists- Representation of Arrays-Stack and Queues – Fundamentals-Evaluation of Expressions.
Sections:2.2,2.4,3.1,3.3

UNIT -III
Linked lists and trees Linked Lists - Singly Linked Lists- Linked Stacks and Queues-More on Linked Lists-Simple algorithms of Doubly Linked Lists (insertion and deletion only).Trees- Binary Trees- Binary Tree Representations- Binary Tree Traversal.
Sections:4.1,4.2,4.5,4.8,5.2,5.3,5.4

UNIT -IV
Search and Sort Divide and conquer - General method - Binary search - Finding the maximum and minimum in a set of items - Merge sort - Quick sort - Selection sort. Basic Traversal and Search Techniques for graphs: Breadth First Search - Depth First Search.
Sections: 3.1 to 3.5,6.2

UNIT -V
Interpolations:Backtracking - The 8-Queens problem - Algebraic problems - Thegeneral method - Evaluation and interpolation - Horner's rule -Lagrange interpolation - Newtonian interpolation.
Sections: 7.1,7.2,9.1,9.2

Recommended text book

1. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran,
Fundamentals of Computer algorithms, Galgotia Publications Pvt.
Ltd., 2004. (Unit I, IV, V)
2. Ellis Horowitz, Sartaj Sahni, Fundamentals of Data Structures,
Galgotia Book Source.,1981.(Unit II, III)

References Text

1.A.V. Aho, J.E.Hopcroft, J.D. Ullman, The Design and Analysisof Computer Algorithms, Addison-Wesley Publ. Comp., 1974.

ELECTIVE - XII
FLUID DYNAMICS

To teach the concept of Velocity of fluid and polars
After the completion of the course the student will be able to solve the problems about viscous flow

UNIT-I
Kinematics of Fluids in motion:Real fluids and Ideal fluids – Velocity of a fluid at a point, Stream lines, path lines, steady and unsteady flows – Velocity potential – The vorticity vector – Local and particle rates of changes – Equations of continuity – worked examples – Acceleration of a fluid – Conditions at a rigid boundary.
Chapter 2: Sec 2.1 - 2.10

UNIT-II
Equations of motion of a fluid:Pressure at a point in a fluid at rest – Pressure at a point in a moving fluid – Conditions at a boundary of two invircid immiscible fluids – Eulers's equation of motion – Discussion of the case of steady motion under conservative body forces.
Chapter 3: Sec 3.1 - 3.7

UNIT- III
Some three dimensional flows:Introduction – Sources, ranks and doublets – Images in a rigid infinite plane – Axis symmetric flows – stokes stream function
Chapter 4: Sec 4.1, 4 .2, 4.3, 4.5

UNIT- IV
Some two dimensional flows:Meaning of two dimensional flow – Use of Cylindrical polar coordinate – The stream function – The complex potential for two dimensional, irrotational in compressible flow – Complex velocity potentials for standard two dimensional flows – Some worked examples – Two dimensional Image systems – The Milne Thompson circle Theorem.
Chapter 5: sec 5.1 - 5.8

UNIT – V
Viscous flows:Stress components in a real fluid – Relations between Cartesian components of stress – Translational motion of fluid elements – The rate of strain quadric and principle stresses – some further properties of the rate of strain quadric – Stress analysis in fluid motion – Relation between stress and rate of strain – The coefficient of viscocity and Laminar flow – The Navier – Stokes equations of motion of a Viscous fluid.
Chapter 8: sec 8.1 - 8.9

Recommended text
F.Chorlton, Text Book of Fluid Dynamics, CBS Publications. Delhi ,1985.

Reference book:
1. G.B. Batchelor, An Introduction of fluid Mechanics, Foundation Books, New Delhi, 1993

ELECTIVE - XIII
ALGEBRAIC THEORY OF NUMBERS

To teach the concept of algebraic numbers
After the completion of the course the student will be able to solve the problems about ring of integers

UNIT – I

Algebraic background: Rings and Fields – Factorization of Polynomials – Field Extensions – Symmetric Polynomials – Modules – Free Abelian Groups.
Chapter I: Section 1.1 - 1.6

UNIT – II

Algebraic Numbers:Algebraic Numbers – Conjugates and Discriminantes – Algebraic Integers – Integral Bases – Norms and Traces – Rings of Integers.
Chapter II: Section 2.1 - 2.6

UNIT – III

Quadratic and Cyclotomic Fields:Quadratic Fields and Cyclotomic Fields.Factorization into Irreducibles: Trivial Factorization – Factorization into Irreducibles – Examples of Non-unique Factorization into Irreducibles.
Chapter III: Section 3.1 - 3.2
Chapter IV: Section 4.2 - 4.4

UNIT – IV

Prime Factorization – Euclidean Domains – Euclidean Quadratic Fields – Consequences of Unique Factorization – The Ramanujan – Nagell Theorem.
Chapter IV: Section 4.5 - 4.9

UNIT – V

Ideals:Prime Factorization of Ideals – The Norms of an Ideal- Non-unique Factorization Cyclotomic Fields.
Chapter V: Section 5.2 - 5.4

Recommended text book

Steward and D.Tall - Algebraic Number Theory and Fermat's Last Theorem(3^{rd} Edition) A.K.Peters Limited, Natrick, Mass,2002.

Refernce books:

1.Z.I.Bosevic and I.R. Safarevic, Number Theory, Academic Press, New York, 1966.
2.J.W.S. Cassels and A.Frohlich, Algebraic Number Theory, Academic Press, New York, 1967.
3.P.Ribenboim, Algebraic Numbers, Wiley, New York, 1972.
4.P.Samuel, Algebraic Theory of Numbers, Houghton Mifflin Company, Boston, 1970.
5.A.Weil, Basic Number Theory, Springer, New York, 1967.

ELECTIVE - XIV
DIFFERENCE EQUATIONS

To introduce the process of discretization, Discrete version of Differential Equations, Discrete oscillation and the asymptotic behaviour of solutions of certain class of difference equations for linear cases only. Solution of difference equations using z-transforms is stressed.

UNIT-I
Linear difference equations of higher order :Difference Calculus - General Theory of Linear Difference Equations - Linear Homogeneous Equations with Constant coefficients - Linear non-homogeneous equations - Method of Undetermined coefficients, the method of variation of constants - Limiting behavior of solutions.
Chapter 2: Sections 2.1 - 2.5

UNIT-II
System of difference equations :Autonomous System - The Basic Theory - The Jordan form - Linear periodic system.
Chapter 3: Section 3.1 - 3.4

UNIT-III
The z-transform method :Definition, Example and properties of Z-transform - The Inverse Z-transform and solution of Difference Equations: Power series method, partial fraction method, the inverse integral method - Volterra Difference Equation of convolution types - Volterra systems.
Chapter 5: Sections 5.1 - 5.3, 5.5 (omit 5.4)

UNIT-IV
Asymptotic behaviour of difference equation :Tools and Approximations - Poincare's Theorem - Second order difference equations - Asymptotic diagonal systems - Higher order Difference Equations.
Chapter 8 : Sections 8.1 - 8.5

UNIT-V
Oscillation theory :Three-term difference Equation - Non-linear Difference Equations - Self-Adjoint second order equations.
Chapter 7 : Sections 7.1 - 7.3

ecommended text book
Saber N. Elaydi, An Introduction to Difference Equations, Springer Verlag, New York, 1996.

Reference Books
1. R.P.Agarwal., Difference Equations and Inequalities, Marcel Dekker, 1999.
2. S. Goldberg, Introduction to Difference Equations, Dover Publications, 1986
3. V. Lakshmi kantham and Trigiante, Theory of Difference Equations, Academic Press, New York, 1988.

ELECTIVE - XV
MATHEMATICAL STATISTICS

This course introduces sampling theory, significance tests ,estimation, testing of hypotheses, ANOVA and sequential analysis with rigorous mathematical treatment.

UNIT-I
Sample moments and their functions :Notion of a sample and a statistic - Distribution of the arithmetic mean of independent normally distributed random variables – The 2 - distribution – The distribution of the statistics – Student's t - distribution - Fisher's Z - distribution - Snedecor's F - distribution - Distribution of sample mean from non-normal populations.
Chapter 9 : Sections 9.1-9.8

UNIT-II
Significance test :Kolmogorov Theorem 10.11.1 - Smirnov Theorem 10.11.2 - Concept of a statistical test - Parametric tests for small samples and large samples - 2 test - Tests of Kolmogorov and Smirnov type - The Wald-Wolfovitz and Wilcoxon -Mann-Whitney tests - Independence Tests by contingency tables.
Chapter 10 : Section 10.11
Chapter 12 :Sections 12.1 - 12.7

UNIT-III
Estimation: Preliminary notion - Consistent estimation - Unbiased estimates - Sufficiency of an estimate - Efficiency of an estimate - Asymptotically most efficient estimates - methods of finding estimates - confidence Interval.
Chapter 13 : Sections 13.1 - 13.8

UNIT-IV
Analysis of Variance :One way classification and two-way classification. Hypotheses Testing: The Power functions and OC function - Most Powerful test - Uniformly most powerful test - unbiased test.
Chapter 15 : Sections 15.1 and 15.2
Chapter 16 : Sections 16.1 -16.5

UNIT-V
Sequential analysis :SPRT - Auxiliary Theorem - Wald's fundamental identity - OC function and SPRT – The expected value of - Determination of A and B - Testing a hypothesis concerning p of zero – one distribution - Testing a hypothesis concerning the expected value m of a Normal population.
Chapter 17 : Sections 17.1-17.9

Recommended text book

M. Fisz , Probability Theory and Mathematical Statistics, John Wiley and sons, New Your, 1963.

Reference Books

1. E.J.Dudewicz and S.N.Mishra , Modern Mathematical Statistics, John Wiley and Sons, New York, 1988.