**M101: ALGEBRA-I**

**Course Outcomes:** The study of M.Sc. degree programme will enable the students:

1. To discuss Normal Subgroups and Normal series like Isomorphism theorem and Automorphism.
2. To explain Structure theorem of Groups like Finitely generated Abelian group and Sylow’s theorem
3. To discribe Ideal's and Homomorphism,Unique Factorization domain and Euclidean domains.

**UNIT-I:** Normal subgroups: Normal subgroups and quotient groups-Isomorphism theorem-Automorphisms - Conjugacy and G-sets- Normal series, solvable groups- Nilpotent groups.

(Section 1,2,3 and 4 of Chapter 5, Sections 1,2,3 of Chapter 6 )

**UNIT-II:** Structure theorems of groups: Direct product- Finitely generated abelian groups- Invariants of a finite abelian group- Sylow’s theorems- Groups of orders p2 ,pq .

(Sections 1 to 5 of Chapter 8)

**UNIT-III:** Ideals and homomorphism- Sum and direct sum of ideals, Maximal and prime ideals-

Nilpotent and nil ideals- Zorn’s lemma.

(Sections 1 to 6 of Chapter 10)

**UNIT-IV:** Unique factorization domains - Principal ideal domains- Euclidean domains-

Polynomial rings over UFD.

(Sections 1 to 4 of Chapter 11)

**Additional Inputs:** Normal subgroups and quotient groups, Isomorphism theorem.

**PRESCRIBED TEXT BOOK:** Basic Abstract Algebra, Second Edition by P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul.

**REFFERECE TEXT BOOK:** Topics in Algrbra By I. N. Herstein.

**M102:REAL ANALYSIS-I**

#### Course Outcomes: The study of M.Sc. degree programme will enable the students:

#### To describe the Basic Topology and Numerical Sequences & Series.

#### To explain about Continuity like Continuity and Connectedness & Continuity and Compactness.

1. To Understand some special theorems of Differentiation like Mean value theorems and Taylor’s theorem and further more learn about Differentiation of vector valued functions.

**UNIT-I:** Basic Topology: Finite-Countable- and Uncountable Sets- Metric spaces- Compact sets- Perfect Sets-Connected sets, The Real and Complex Number systems –Ordered sets , Fields.

(Chapter 2 of the text book)

**UNIT-II:** Numerical Sequences and Series: Convergent Sequences- Subsequences -Cauchy Sequences- Upper and Lower limits- Some Special Sequences- Series- Series of Non-negative Terms- The number e -The Root and Ratio tests- Power series -Summation by parts - Absolute Convergence-Addition and Multiplication of series-Rearrangements.

(Chapter 3 of the text book)

**UNIT-III:** Continuity: Limits of Functions- Continuous Functions- Continuity and Compactness- Continuity and Connectedness- Discontinuities- Monotonic Functions- Infinite Limits and Limits at Infinity.

(Chapter 4 of the text book)

**UNIT-IV:** Differentiation: The Derivative of a Real Function -Mean Value Theorems - The Continuity of Derivatives- L’ Hospital’s Rule- Derivatives of Higher order- Taylor’s theorem- Differentiation of Vector- valued Functions.

(Chapter 5 of the text book)

**Additional Inputs:** The Real and Complex Number systems –Ordered sets , Fields.

**PRESCRIBED TEXT BOOK:** Principles of Mathematical Analysis by Walter Rudin, International Student Edition, 3rd Edition, 1985.

**REFERENCE TEXT BOOK:** Mathematical Analysis by Tom M. Apostal, Narosa Publishing House, 2nd Edition,1985.

**M103:DIFFERENTIAL EQUATIONS**

**Course Outcomes:** The study of M.Sc. degree programme will enable the students:

1. To discuss the second order linear differential equations and analyze homogeneous equation with constant coefficients, undetermined coefficients and method of variation of parameters.
2. To explain Oscillation theory and Boundary value problems like Eigen values and Eigen functions.
3. To describe Power series solutions and Systems of first order equations.

**UNIT-I:** Second order linear differential equations: Introduction-general solution of the homogeneous equation - Use of a known solution to find another - Homogeneous equation with constant coefficients - method of undetermined coefficients - method of variation of parameters.

Chapter 3 (Sec 14-19)

**UNIT-II:** Oscillation theory and boundary value problems: Qualitative properties of solutions – The Sturm comparison theorem - Eigen values, Eigen functions and the vibrating string.

Chapter 4 (Sec 22-24, Appendix A)

**UNIT-III:** Power series solutions: A review of power series-series solutions of first order equations-

second order linear equations - ordinary points-regular singular points-Gauss’s hypergeometric equation.

Chapter 5 (Sec 25-30)

**UNIT-IV:** Systems of first order equations: Linear systems - Homogeneous linear systems with constant coefficients - Existence and Uniqueness of solutions - successive approximations - Picard’s theorem - Some examples.

Chapter 7 (Sec 36-38) and Chapter 11(Sec 55-56)

**Additional Inputs:** Gauss’s hypergeometric equation.

**PRESCRIBED TEXT BOOK:** George F. Simmons, Differential Equations, Tata McGraw-Hill Publishing Company Limited, New Delhi.

**\**

**M104:TOPOLOGY**

**Course Outcomes:** The study of M.Sc. degree programme will enable the students:

1. To discuss the basic concepts of Sets and Functions and also know about Countable Sets &​ Uncountable Sets, further more about Partitions and equivalence relations.
2. To learn about Metric spaces like open sets, closed sets and continuous mappings and also learn about Euclidean and unitary spaces.
3. To describe Compactness like compact spaces, Product of spaces and discuss about some important theorems like Tychnoff's Theorem and Ascoli's theorem.

**UNIT-I:**Sets and Functions: Sets and Set inclusion – The algebra of sets – Functions – Products of sets– Partitions and equivalence relations – Countable sets – Uncountable sets – Partially ordered sets and lattices.

(Chapter I: Sections 1 to 8.)

**UNIT-II:** Metric spaces: The definition and some examples – Open sets – Closed sets – Convergence, Completeness and Baire’s theorem – Continuous mappings.

(Chapter 2: Sections 9 to 13.)

**UNIT-III:** Metric spaces (Continued): Spaces of continuous functions – Euclidean and unitary spaces.

Topological spaces: The definition and some examples – Elementary concepts – Open bases

and open sub bases – Weak topologies – The function algebras C(X, R) and C(X, C).

(Chapter 2: Sections 14,15 and Chapter 3: 16 to20.)

**UNIT-IV:** Compactness: Compact spaces – Product of Spaces – Tychonoff’s theorem and locally

Compact spaces – Compactness for metric spaces – Ascoli theorem – Limit point compactness

(Chapter 4: Sections 21 to 25.)

**Additional Inputs:** limit point compactnesss.

**PRESCRIBED TEXT BOOK-1:** Introduction to Topology by G.F.Simmons, Mc.Graw-Hill book company.

**PRESCRIBED TEXT BOOK – 2:** Topology by James R. Munkers,Second edition ,Pearson education Asia – Low price edition.

**M105:DISCRETE MATHEMATICS**

**Course Outcomes:** The study of M.Sc. degree programme will enable the students:

1. To discuss lattices as partially ordered sets, some properties of lattices, lattices as

algebraic systems.

1. To acquire the knowledge from Boolean forms and free Boolean algebras, values of

Boolean expressions.

1. To Describe representations and minimizations of Boolean functions and to explain finite state machines, Introductory sequential circuits, equivalence of Finite state Machines.

**UNIT-I:**Relations and ordering: Relations- properties of binary relations in a set-Relation matrix and the graph of a relation, partition and covering of a set, equivalence relations, compatability relation, composition of binary relations- partially ordereing- Partially ordered sets - representation and associated terminology.

[ 2-3.1 to 2-3.9 of Chapter 2 of the Text Book]

**UNIT-II:**Lattices: Lattices as partially ordered sets - some properties of Lattices - Lattices as algebraic systems - sub-Lattices - direct product and homomorphism some special Lattices.

[4-1.1 to 4-1.5 of Chapter 4 of the Text Book]

**UNIT-III:**Boolean Algebra: Sub algebra - direct product and Homorphism - Boolean forms and free Boolean Algebras - values of Boolean expressions and Boolean function.

[4-2.1,4-2.2,4- 3.1, 4-3.2 of Chapter 4 of the Text Book]

**UNIT-IV:**Representations and minimization of Boolean Function: Representation of Boolean functions – minimization of Boolean functions- Finite State Machines - Introductory Sequential Circuits - Equivalence of Finite-State Machines, Connectives – Negation , Conjunction , Disjunction , Statement formulas and Truth tables.

[4-4.1,4-4.2,4-6.1, 4-6.2 of Chapter 4 of the Text Book]

**Additional Inputs:** Connectives – Negation , Conjunction , Disjunction , Statement formulasand Truth tables.

**PRESCRIBED TEXT BOOK:**Discrete Mathematical structures with applications to Computer Science by J.P.Trembly and R. Manohar, Tata McGraw-HillEdition.

**REFERENCE TEXT BOOKS:1.**Discrete Mathematics for Computer Scientists and Mathematicians by J.L.Mott, A.Kandel and T.P. Baker, Prentice-Hall India.

**2.** Discrete Mathematical Structures by Kolman & Busby & Sharen Ross

**3.** Applied Abstract Algebra by Rudolf Lidl & Gunter Pilz ,Published by springer Verlag.

**M201:ALGEBRA-II**

**Course Outcomes:** The study of M.Sc. degree programme will enable the students:

**1.**To discuss about Rings of Fractions and Algebraic Extensions of Fields.

2.To explain Normal and Separable extensions like Splitting fields, Multiple roots and Finite fields.

3.To discuss about Galois theory and it’s applications to classical problems like cyclic extensions, Roots of Unity and Cyclotomic polynomials.

**UNIT-I:** Rings of fraction: Rings of fraction-Rings with Ore condition, Algebraic extensions of fields: Irreducible polynomials and Eisenstein criterion- Adjunction

of roots- Algebraic extensions-Algebraically closed fields.

(Sections 1&2of chapter 12, section 1 to 4 of Chapter 15 )

**UNIT-II:** Normal and separable extensions: Splitting fields- Normal extensions- Multiple roots- Finite fields- Separable extensions.

(Sections 1 to 5 of Chapter 16 )

#### UNIT-III: Galois theory: Automorphism groups and fixed fields- Fundamental theorem of Galois theory-Fundamental theorem of Algebra.

#### (Sections 1 to 3 of Chapter 17 )

#### UNIT-IV: Applications of Galioes theory to classical problems: Roots of unity and cyclotomic polynomials- Cyclic extensions- Polynomials solvable by radicals - Ruler and Compass constructions.

#### (Sections 1 to 3 and 5 of Chapter 18)

**Additional Inputs:** Rings of fraction,Rings with Ore condition

**PRESCRIBED TEXT BOOK:** Basic Abstract Algebra , Secound Editionby P.B. Bhattacharya, S.K. Jainand S.R. Nagpaul

**REFERENCE TEXT BOOK:** Topics in Algrbra By I. N. Herstein.

**M202:REAL ANALYSIS-II**

**Course Outcomes:** The study of M.Sc. degree programme will enable the students:

1. To describe the Riemann stieltjes Integral and Sequences and Series of the functions like​ Uniform convergence, Uniform convergence and Continuity and Integration further more know about Equicontinuous families of functions,the stone wierstrass theorem.
2. To explain the concept of Power Series and Functions of Several Variables like linear transformations ,the contraction principle and the inverse function theorem.
3. To learn about the the Implicit function theorem,the Rank theorem and further more about Derivatives of higher order and Differentiation of integrals.​

#### UNIT-I: Riemann-Stieltjes Integral: Definition and existence of the Riemann Stieltjes Integral,Properties of the Integral, Integration and Differentiation, the fundamental theorem of calculus– Integral of Vector- valued Functions, Rectifiable curves.

(Chapter 6)

#### UNIT-II:Sequences and Series of the Functions: Discussion on the Main Problem, Uniform Convergence, Uniform Convergence and Continuity, Uniform Convergence and Integration, Uniform Convergence and Differentiation, Equicontinuous families of Functions, the Stone- Weierstrass Theorem.(Chapter 7)

**UNIT-III:** Power Series (A section in Chapter 8 of the text book) , the exponential and logarithmic functions.Functions of Several Variables: Linear Transformations, Differentiation, The ContractionPrinciple, The Inverse Function theorem.

(First Four sections of chapter 9 of the text book)

**UNIT-IV:** Functions of several variables Continued: The Implicit Function theorem, The Rank theorem, Determinates, Derivatives of Higher Order, Differentiation of Integrals.

(5 th to 9 th sections of Chapter 9 of the text book)

**Additional Inputs:** The exponential and logarithmic functions.

**PRESCRIBED TEXT BOOK:** Principles of Mathematical Analysis by Walter Rudin, International Student Edition, 3 rd Edition, 1985.

**REFERENCE TEXT BOOK:**Mathematical Analysis by Tom M. Apostal, Narosa Publishing House,2 nd Edition, 1985.

**M203:COMPLEX ANALYSIS-I**

**Course Outcomes:** The study of M.Sc. degree programme will enable the students:

1. To discuss the elementary properties and examples of Analytic functions like Power series and Mobius transformations.
2. To study complex integration and analyze Riemann-Stiltjes integrals, Cauchy theorem and Integral formula.
3. To describe classification of Singularities, Residues and argument principle.

#### UNIT-I: Elementary properties and examples of analytic functions: Power series- Analytic functions-Analytic functions as mappings, Mobius transformations.

#### (1,2,3 of chapter-III)

#### UNIT-II:Complex Integration: Riemann- Stieltjes integrals- Power series representation ofanalyticfunctions- zeros of an analytic functions- The index of a closed curve.

(1,2,3,4 of chapter-IV)

**UNIT-III:**Cauchy’s theorem and integral formula- the homotopic version of Cauchy’s theorem andsimple connectivity- Counting zeros; the open mapping theorem.

(5,6,7of chapter-IV )

**UNIT-IV:** Singularities: Classifications of singularities- Residues- The argument principle,

The Maximum Modulus Theorem:The Maximum Principle-Schwarz’s Lemmma

(1,2,3 of chapter-V ,1,2 of chapter-VI )

**Additional Inputs:**The Maximum Modulus Theorem:The Maximum Principle-Schwarz’s Lemma

**PRESCRIBED TEXT BOOK:** Functions of one complex variables by J.B.Conway : Second edition,

Springer International student Edition, Narosa Publishing House, NewDelhi.

**REFERENCE TEXT BOOK:** A first course in complex analysis with applications by Dennis G.Zill and Patrick Shanahan.

**M204:LINEAR ALGEBRA**

**Course Outcomes:** The study of M.Sc. degree programme will enable the students:

1. To Explain elementary canonical forms, annihilating polynomials, invariant

subspaces.

**2.** ToDescribe direct –sum decompositions, invariant direct-sums.

**3.**  ToAcquire the knowledge in the Jordan forms, computation of invariant factors,

semi simple operators.

#### UNIT-I:Elementary Canonical Forms : Introduction – Characteristic Values – Annihilating Polynomials –invariant subspaces – Simultaneous Triangulation – Simultaneous Diagonalization.

(Sections 6.1,6.2,6.3,6.4,6.5 of chapter-6)

**UNIT-II:** Direct – sum Decompositions – invariant direct sums – the primary decomposition theorem –cyclic subspaces and Annihilators – cyclic decompositions and the rational form.

(Sections 6.6,6.7,6.8 of chapter-6 and Sections 7.1,7.2 of chapter - 7)

**UNIT-III:** The Jordan Form – Computation of Invariant Factors – Semi Simple Operators, Linear Transformations.(Sections 7.3,7.4,7.5 of chapter - 7)

**UNIT-IV:** Bilinear Forms : Bilinear Forms – Symmetric Bilinear Forms – Skew Symmetric Bilinear Forms– Group Preserving Biliear Forms.

(Sections 10.1,10.2,10.3,10.4 of chapter - 10)

**Additional Inputs :** Linear Transformations.

**PRESCRIBED TEXT BOOK:** Linear Algebra second edition By Kenneth Hoffman and Ray Kunze, PrenticeHall of india Private Limited, New Delhi.

**REFERENCE TEXT BOOK:** SCHAUM’S outlines by MURRAY,R.SPIEGEL, JOHN SCHILLER, R.ALU SRINIVASAN.

**M205: PROBABILITY THEORY & STATISTICS**

**Course Outcomes:** The study of M.Sc. degree programme will enable the students:

1. It gives insight about the concepts, definitions and theorems of Probability and analyze the Probability distributions like Binomial, Poisson and Normal distributions.
2. Describe correlation and regression analysis concepts.
3. Understand the concepts of sampling and explain the large sample test.

**UNIT-I**:Sample Space & Events, Axioms of Probability, Some theorems on Probability, Boole’s inequality, Conditional probability, Multiplication theorem on probability, Independent events, Multiplication theorem on probability for Independent Events, Extension of Multiplication theorem on probability to n events, Pair-wise Independent Events, Baye’s theorem

[ Section 3.8 to 3.15 , Page no: 3.2 to 3.98 & Section 4.2, Page no: 4.4 to 4.20]

**UNIT-II:**Distribution function, Discrete Random variables, Continuous random variables, Mathematical Expectation, Expected value of function of a random variable, Properties of Expectation, Properties of variance, Covariance, Moment Generating Function, Characteristic function, Binomial Distribution, Poisson Distribution, Normal Distribution,Uniform Distribution, Random Experiment, Mutually exclusive events, Exhaustive number of cases, Population, Level of significance and Degrees of freedom.

[Section5.2to5.4,Pageno:5.2 to5.31,Section6.2to6.6,Pageno:6.1to6.22,Section

7.1, 7.3(7.3.1&7.3.2 only), Page no: 7.2 to 7.6, Page no: 7.9 to 7.15, Section 8.4, 8.5,Page

no:8.4to8.47,Section9.2.1to9.2.11and9.2.14,9.3, Pageno:9.2to9.12,9.14to9.28,and 9.3 to 9.37]

**UNIT-III:** Correlation: Introduction, meaning of correlation, scatter diagram, Karl Pearson’s Coefficient of Correlation, Rank Correlation, Linear and Curvilinear Regression:Introduction, linear regression, curvilinear regression

[Section 10.1 to 10.4(10.4.1, 10.4.2 only & in 10.7 –10.7.1 only), Page no: 10.1 to 10.16

and 10.23 – 10.25, Section 11.1 to 11.3, Page no: 11.1 to 11.19]

**UNIT-IV:**Large Sampling theory: Introduction, types of sampling, parameters and

statistic, tests of significance, procedure for testing of hypothesis, tests of significance for large samples.

[Section 14.1 – 14.6, Page no: 14.1 to 14.22]

**Additional Inputs** : Random Experiment, Mutually exclusive events, Exhaustive number of cases, Population, Level of significance and Degrees of freedom.

**PRESCRIBED TEXT BOOK:** Fundamentals of Mathematical Statistics, S.C.Gupta,V.K.Kapoor Eleventh Thoroughly Revised Edition Published by: Sultan Chand & Sons, NEW-DELHI.

**REFERENCE TEXT BOOK:** Statistical methods by S.P Gupta.

**M301: FUNCTIONAL ANALYSIS**

**Course Outcomes:** The study of M.Sc. degree programme will enable the students:

1. To discuss the Banach spaces definition with examples, continuous linear transformation, the Hahn- Banach theorem and the natural imbedding of N in N\*\*.
2. To discuss Hilbert spaces the definition and some simple properties, orthogonal complements and orthonormal sets.
3. To explain Finite- dimensional spectral theory Matrices, determinants and the spectrum of an operator and the spectral theorem.

**UNIT-I Banach spaces**: the definition and some examples, continuous linear transformation, the Hahn-

Banach theorem, the natural imbedding of N in N\*\*, The open mapping theorem.

(Sections 46 – 50 of chapter 9)

#### UNIT-II The conjugate of an operator, Hilbert spaces: The definition and some simple properties,

orthogonal complements, orthonormal sets.

(Sections 51 of chapter 9 and Sections 52- 54 of chapter 10)

#### UNIT-III The Conjugate space H\*, the ad joint of an operator, Self- ad joint operators, Normal and

Unitary operators, Projections.

(Sections 55 - 59 of chapter 10)

#### UNIT-IV Finite- dimensional spectral theory: Matrices, determinants and the spectrum of an operator,the spectral theorem, A survey of the situation.

(Sections 60 - 63 of chapter - 11)

**PRESCRIBED TEXT BOOK:** Introduction to Topology and Modern Analysis by G.F.Simmons, McGraw Hill Book Company, Inc-International student ed.

**REFERENCE TEXT BOOK:** First course in functional analysis by Casper-Goffman, George pedrick.

**M302:LEBESGUE THEORY**

**Course Outcomes:** The study of M.Sc. degree programme will enable the students:

1. To discuss Algebra of sets, Lebesgue measure, Outer measure, Measurable set and Lebesgue measure etc.
2. To discuss the Riemann integral, the Lebesgue integral of a bounded function over a set of finite measures etc.
3. To discuss Differentiation of monotonic functions, functions of bounded variation, differentiation of an integral, absolute continuity, Lp- Spaces the Holder’s and Minkowski inequalities etc.

**UNIT-I :**Algebra of sets, Lebesgue measure, Outer measure, Measurable set and Lebesgue measure, a non-measurable set, measurable function, Little woods’s Three principles.(Chapter 3)

#### UNIT-II :The Riemann integral, the Lebesgue integral of a bounded function over a set of finite measures, the integral of a non-negative function, the general Lebesgue integral convergence in measure. (Chapter 4)

#### UNIT-III : Differentiation of monotonic functions, functions of bounded variation, differentiation of an

integral, absolute continuity. (Chapter 5)

#### UNIT-IV :Lp- Spaces the Holder’s and Minkowski inequalities, convergence and completeness

(Chapter 6)

**PRESCRIBED TEXT BOOK:** H.L.Royden, Real Analysis, Macmillan Publishing Company, New York,

Third Edition, 1988.

**REFERENCE TEXT BOOK:** Real Analysis by H.L.Roydan, P.M.Fitzpatrick

**M303: ANALYTICAL NUMBER THEORY**

**Course Outcomes:** The study of M.Sc. degree programme will enable the students:

1. To discuss basic concepts of arithemetical functions and dirichlet multiplication like Mobius function µ(n), Euler quotient function φ(n), Mangoldt function , Multiplicative functions, Liouville’s function λ(n), Divisor functions - and Generalized convolutions.
2. To explain Averages of arithemetical functions, big oh notation, Euler’s summation formula, The average order of d(n), The average order of the divisor functions , The average order of φ(n),application to the distribution of lattice points visible from the origin and applications to µ (n) and .
3. To discuss some elementary theorems on the distributions of prime numbers chebyshev’s function ψ(x) and , Relations connecting and π(x), Some equivalent forms of the prime number theorem, Shapiro’s Tauberian theorem, Definition and basic properties of congruences, Euler-Fermat theorem, Polynomial congruences modulo p. Lagrange’s theorem and it’s applications, Chinese remainder Theorem and it’s applications etc.

**UNIT-I:** ARITHMETICAL FUNCTIONS AND DIRICHLET MULTPLICATION :-Introduction – The Mobius function µ (n).-The Euler quotient function φ(n)-A relation connecting φ and µ- A product formula for φ(n)-The Dirichlet product of arithmetical functions- Dirichlet inverses and the Mobius inversion formula- The mangoldt function - multiplicative functions- multiplicative function and Dirichlet multiplication – The inverse of a completely multiplicative function- Liouville’s function λ(n)- The divisor functions - Generalized convolutions.

(Sections 2.1 – 2.14 of chapter 2)

#### UNIT-II : AVERAGES OF ARITHMETICAL FUNCTIONS:- Introduction- The big oh notation. Asymptotic equality of functions – Euler’s summation formula – Some elementary asymptotic formulas – The average order of d(n)-The average order of the divisor functions - The average order of φ(n)-An application to the distribution of lattice points visible from the origin– the average order of µ (n) and – The partial sums of a Dirichlet product- Applications to µ (n) and – Another identity for the partial sums of a Dirichlet product.

(Sections 3.1 – 3.12 of chapter 3)

#### UNIT-III :SOME ELEMENTARY THEOREMS ON THE DISTRIBUTION OF PRIME NUMEBRS:-

Introduction – chebyshev’s function ψ(x) and - Relations connecting and π(x) – Some equivalent forms of the prime number theorem - Inequalities for π(n) and pn – Shapiro’s Tauberian theorem – Applications of Shapiro’s theorem – An asymptotic formula for the partial

sums- The partial sums of the Mobius function- Selberg’s asymptotic formula.

(Sections 4.1 to 4.9 and 4.11 of Chapter 4)

#### UNIT-IV : CONGRUENCES :- Definition and basic properties of congruences – Residue classes and complete residue systems – linear congruences – Reduced residue systems and the Euler-Fermat theorem – Polynomial congruences modulo p. Lagrange’s theorem –Applications of Lagrage’s theorem – Simultaneous linear congruences. The Chinese remainder Theorem- Applications of the Chinese remainder Theorem – Polynomial congruences with prime power moduli.

(Sections 5.1 – 5.9 of chapter 5)

**Additional Input:** Selberg’s asymptotic formula.

**PRESCRIBED TEXT BOOK :** Introduction to Analytic Number Theory – By T.M.APOSTOL – Springer Verlag New York, Heidlberg – Berlin – 1976.

**REFERENCE TEXT BOOK:** Analytical Number Theory: An Introductory course by Harold G.Diamond and Paul T.Bateman.

**M304:PARTIAL DIFFERENTIAL EQUATIONS**

**Course Outcomes:** The study of M.Sc. degree programme will enable the students:

1. To discuss about basics of partial differential equations and method of solutions of dx/P = dy/Q = dz/R and know about pfaffian differential forms and equations and their solutions in three variables.
2. To describe linear & non-linear equations of the first order and solving the orthogonal surfaces and compatible systems of first order equations further more about some methods like,charpit's method,jacobi's method.
3. To solve the second order partial differential equations and discuss about solutions f linear hyperbolic equations and explaining method of separation of variables,monger's method and further more about Laplace equation and some elementary solutions and solving boundary value problems and more about wave equation and elementary solution in one dimensional form.

**UNIT I:** Introduction, Methods of Solution of dx/P = dy/Q = dz/R, Orthogonal trajectories of a system of curves on a surface, Pfaffian Differential forms and equations, Solutions of Pfaffian differential equations in three variables, Cauchy’s problem for first order partial differential equations.

( Sections 3 to 6 of Chapter 1, Sections 1 to 3 of Chapter 2)

**UNIT II:** Linear Equations of the first order, Integral surfaces, orthogonal surfaces, non linear partial differential equations of the first order, Cauchy’s method of characteristics, Compatible systems of first order equations, Charpit’s Method, Special types of first order equations, Jacobi’s method.

( Sections 4 to 13 of Chapter 2)

**UNIT III:** Partial Differential Equations of the second order, Their origin, Linear partial Differential equations with constant and variable coefficients, Solutions of linear hyperbolic equations, Method of separation of variables, Monger’s method. (Sections 1 to 5 and Sections 8,9,11 of Chapter 3)

**UNIT IV:** Laplace Equation, elementary solutions, families of equipotential surfaces, Boundary value problems, Method of separation of variables of solving Laplace equation, problems with axial symmetry, Kelvin’s inversion theorem, The wave equation, Elementary solution in one dimensional form, Riemann-Volterra solution of one dimensional wave equation, The theory of Green’s function for laplace’s equation.

(Sections 1 to 8 of Chapter 4 and Sections 1 to 3 of Chapter 5)

**Additional Inputs:** The theory of Green’s function for laplace’s equation

**PRESCRIBED TEXT BOOK:** Elements of Partial Differential Equations by I.N.Sneddon, Mc Graw Hill,

International Edition, Mathematics series.

**REFERENCE BOOK:** Fritz John, Partial Differential Equations, Narosa Publishing House, New Delhi, 1979

**M305.2: COMMUTATIVE ALGEBRA**

**Course Outcomes:** The study of M.Sc. degree programme will enable the students:

1. To explain the concepts of Rings and ring homomorphism, ideals, quotient rings, prime ideals and Maximal ideals, nil radical and Jacobson radical.
2. To study Modules and module homomorphisms, Sub modules and quotient modules, operations on submodules, direct sum and product, finitely generated modules and exact sequences.
3. To discuss the topics Local Properties, Extended and Contracted ideals in rings of fractions and Primary decompostitions.

**UNIT-I :**Rings and ring homomorphism, ideals, quotient rings, zero divisors, Nilpotent elements, units, prime ideals and Maximal ideals, nil radical and Jacobson radical, operations on ideals, Extensions and contractions.

#### UNIT-II :Modules and module homomorphisms, Sub modules and quotient modules, operations on submodules, direct sum and product, finitely generated modules, exact sequences, Tensor product of modules, Restriction and extension of scalars, Exactness properties of the tensor product, algebras, tensor product of algebras.

#### UNIT-III :Local Properties, Extended and Contracted ideals in rings of fractions.

#### UNIT-IV : Primary decompostitions, Integral Dependence (Content and extent of chapters 1 to 4 of the prescribed text book)

**Additional Inputs:** Integral Dependence.

**PRESCRIBED TEXT BOOK:** Introduction to commutative algebra, M.F.ATIYAH and I.G.MACDONALD,

Addision – Wesley publishing Company, London.**REFERENCE TEXT BOOK:** Commutative Algebra book by Hideyuki Matsumura.

**M305.3: COMPLEX ANALYSIS - II**

UNIT-I: The maximum modulus theorem: The maximum principle – Schwarz’s lemma – convex

function’s and hadamard’s three circles theorem – Phargmem – Lindelof theorem.

(1,2,3,4 of chapter-VI)

#### UNIT-II:Compactness and Convergence in the Space of Analytic Functions: The space of continuous function C ( G, Ω) – Spaces of Analytic functions – spaces of meromorhic functions – The Riemann Mapping Theorem – Weierstrass factorization theorem – Factorization of sine functions. .

(1,2,3,4,5,6 of chapter-VII)

#### UNIT-III: Runge’s Theorem : Runge’s Theorem – Simple connectedness – Mittang – Leffler’s Theorem, Analytic Continuatin and Riemann Surfaces, Schwarz Reflection Principle – Analytic Continuatin Along A Path – Mondraomy Theorem..

(1,2,3 of chapter-VIII and 1,2,3 of chapter IX)

#### UNIT-IV:Harmonic Functions : Basic properties of Harmonic functions – Harmnic functions on a disk. Jenson’s formula, the genus and the order of an entire function Hadamard’s factorization theorem. .

(1,2, of chapter-X and 1,2,3 of chapter XI )

**PRESCRIBED TEXT BOOK**: Functions of one complex variables by J.B.Conway : Second edition,

Springer International student Edition, Narosa Publishing House, New Delhi

**M401:MEASURE THEORY**

**Course Outcomes:** The study of M.Sc. degree programme will enable the students:

1. To discuss Convergence and Completeness, Measure spaces, Measurable functions, Integration, General convergence Theorems.
2. To discuss Signed Measures, The Raydon-Nikodym Theorem, the Lp spaces, Outer Measure and Measurability, The Extension theorem, The Lebesgue - Stieltjes Integral and Product measures.
3. To discuss Integral Operators, Inner Measure, Extension by sets of measure zero, caratheodory outer measure and Hausdroff Measure.

**UNIT- I :** Convergence and Completeness, Measure spaces, Measurable functions, Integration, General convergence Theorems.[Section 3 of Chapter 6, Section 1 to 4 of Chapter 11 of the text book]

**UNIT- II :** Signed Measures, The Raydon-Nikodym Theorem, the Lp spaces. [Sections 5 to 7 of Chapter 11 of the text book]

**UNIT- III :** Outer Measure and Measurability, The Extension theorem, The Lebesgue - Stieltjes Integral, Product measures.[Sections 1 to 4 of Chapter 12 of the text book]

**UNIT- IV :**Integral Operators, Inner Measure, Extension by sets of measure zero, caratheodory outer measure, Hausdroff Measure.

[Sections 5 to 9 of Chapter 12 of the text book]

**PRESCRIBED** **TEXT BOOK:**Real Analysis by H. L. Royden, Macmillan Publishing Co. Inc. 3 rd Edition, New York, 1988.

**REFERENCE TEXT BOOK:** Real Analysis by H.L.Roydan, P.M.Fitzpatrick

**M402: NUMERICAL ANALYSIS**

**Course Outcomes:** The study of M.Sc. degree programme will enable the students:

1. To perform the iterations for the smallest root by using Bisection method, Regulafalsi method, Newton- Raphson method, Mullers method, Chebyshev method, Multipoint iterative method and secant method.
2. To discuss the iterations for the smallest root by using Guass elimination method, Triangularization method, Cholesky method, Lagrange and Newton’s divided difference interpolation, sterling and Bessel interpolation, Hermite interpolation, piecewise and Spline Interpolation method.
3. To find the smallest root by using Gauss Legendre Integration method, Euler’s method, Taylor series method, Runge kutte second and forth order methods.

**UNIT I :**Transcendental and polynomial equations: Introduction, Bisection method, Iteration methods based on first degree equation; Secant method, Regulafalsi method, Newton- Raphson method, Iteration method based on second degree equation; Mullers method, Chebyshev method, Multipoint iterative method, Rate of convergence of secant method, Newton Raphson method,

(Section 1 of the Text Book pages 1 to 52 above specified methods only)

#### UNITII : System of linear algebraic equation: Direct methods, Guass elimination method, Triangularization method, Cholesky method, Partition method, Iteration method: Gauss seidel Iterative method, OR method.

(Section 2 of the Text Book pages 53 to 169 above specified methods only)

#### UNIT III : Interpolation and Approximation: Introduction, Lagrange and Newton’s divided difference interpolation, Finite difference operators, sterling and Bessel interpolation, Hermite interpolation, piecewise and Spline Interpolation, least square approximation.

(Section 3 of the Text Book pages 210 to 300 above specified methods only)

#### UNIT IV : Numerical Differentiation: methods based on Interpolation, methods based on Finite difference operators Numerical Integration: methods based on Interpolation, Newton’s cotes methods, methods based on Undetermined coefficients, Gauss Legendre Integration method, Numerical methods ODE: Single step methods: Euler’s method, Taylor series method, Runge kutte second and forth order methods, Multistep methods: Adam Bash forth method, Adam Moulton methods, Milne-Simpson method.

(Section 4 of the Text Book pages 320 to 495 above specified methods only)

**PRESCRIBED TEXT BOOK:** Numerical Methods for Scientific and Engineering computation by M.K.

Jain, S.R.K. Iyengar, R.K. Jain, New Age Int. Ltd., New Delhi.

**REFERENCE TEXT BOOK:** Introduction to Numerical Analysis, by S.S. Sastry,Prentice Hall Flied.

**M403:GRAPH THEORY**

**Course Outcomes:** The study of M.Sc. degree programme will enable the students:

1. To understand the basic concepts of graphs and about trees & fundamental circuits.
2. To discuss about cutsets & cut vertices and planar & dual graphs, further more ,to learn about the matrix representation of graphs like, Incidence, Circuit,Path and Adjacency matrices of graphs.
3. To explain about the concepts of coloring , covering and partitioning of graphs and at athe end of the chapter we learn about graph theory in operation research.

## UNIT-I: Basic concepts, Paths and Circuits, Trees andFundamental Circuits.

## [Chapters 1, 2, 3 of the text book]

**UNIT-II:** Cut Sets and Cut Vertices: Cut sets, Some properties of a cut set, All cut sets in a graph, Fundamental circuits and cut sets, Connectivity and Separability, Network Flows, 1- Isimorphsm, 2-Isomorphsm; Planar and Dual Graphs: Combinatorial Vs Geometric graphs, Planar graphs, Kuratowski’s Two graphs, Different Representations of Planar Graphs, Detection of Planarity, Geometric Dual, Combinational Duals of a Graph,

[Chapter 4 and Sections 5.1 to 5.7 of Chapter 5 of the text book]

**UNIT-III:** Matrix Representation of graphs: Incident matrix of a Graph, Sub Matrices of A(G), Circuit Matrix, Fundamental Circuit Matrix and Rank of B, An Applications to a Switching Network, Cut set matrix, Relationship among Af, Bf and Cf,, Path Matrix and Adjacency Matrix, Directed Graphs:What is a digraph? Some types of digraph,Matrices A,B & C of digraphs. [Chapter 7 & 9.1,9.2,9.8 of chapter-9 of the text book]

**UNIT-IV:** Coloring, Covering and Partitioning: Chromatic Number, Chromatic Partitioning, Chromatic Polynomial, Matchings, Coverings, The four color Problem; Graph Theory in Operation Research: Transport networks, Extensions of Max-flow Min cut theorem, Minimal cost flows.

[Chapter 8 and Sections 14.1 to 14.3 of Chapter 14 of the text book]

**Additional Inputs:** Directed Graphs:What is a digraph? Some types of digraph,Matrices A,B & C of digraphs.

**PRESCRIBED TEXTBOOK:**  Graph Theory with applications to Engineering and computer Science by Narsingh Deo; Prentice-Hall of India.

**REFERENCES: 1.** Graph Theory with applications by Bond JA and Murthy USR, North Holland, NewYork.

**2**. Introduction to Graph Theory by Donglas B. West. Prentice Hall of India.

**M404: LINEAR PROGRAMMING**

**Course Outcomes:** The study of M.Sc. degree programme will enable the students:

1. To study the concepts of formulation of Linear Programming problems, Graphical solution, General formulation and Simplex Method.
2. To solve the problems by using the methods two-phase, Big-M, degeneracy, Concept of Duality in Linear Programming, Comparison of solutions of the Dual and its primal.
3. Mathematical formulation of Assignment problem, Reduction theorem, Hungarian Assignment Method, Travelling salesman problem, Mathematical formulation of Transportation problem, North West corner rule, Lowest cost entry method, Vogel's approximation methods,

**UNIT I :** Definition of O.R, Decision method of O.R, Methodology of O.R, Application of O.R, Concept of Dual Simplex method, Formulation of Linear Programming problems, Graphical solution of Linear Programming problem, General formulation of Linear Programming problems, Standard and Matrix forms of Linear Programming problems, Simplex Method.

### [Sections 3.1 to 3.7 of Chapter 3 and Section 5.4 of Chapter 5 of the text book]

#### UNIT II :Two-phase method, Big-M method, Method to resolve degeneracy in Linear Programming problem, Alternative optimal solutions. Solution of simultaneous equations by simplex Method, Inverse of a Matrix by simplex Method, Concept of Duality in Linear Programming, Comparison of solutions of the Dual and its primal.

### [Sections 5.5, 5.7, 5.8, 5.12, 5.13 of Chapter 5 and Sections 7.1, 7.7 of Chapter 7]

#### UNIT III : Mathematical formulation of Assignment problem, Reduction theorem, Hungarian Assignment Method, Travelling salesman problem, Formulation of Travelling Salesman problem as an Assignment problem, Solution procedure.

### [Sections 12.1 to 12.4, 12.9 of Chapter 12 of the text book]

#### UNIT IV : Mathematical formulation of Transportation problem, Tabular representation, Methods to find initial basic feasible solution, North West corner rule, Lowest cost entry method, Vogel's approximation methods, Optimality test, Method of finding optimal solution, Degeneracy in transportation problem, Method to resolve degeneracy, Unbalanced transportation problem.

#### [Sections 11.1 to 11.5 and 11.8 to 11.12 of Chapter 11 of the text book]

**Additional Inputs:** Definition of O.R, Decision method of O.R, Methodology of O.R, Application of O.R, Concept of Dual Simplex method.

**PRESCRIBED TEXT BOOKS:** S. D. Sharma, Operations Research.

**REFERENCE BOOKS:**

1. Kanti Swarup, P. K. Gupta and Manmohan, Operations Research.
2. H. A. Taha, Operations Research – An Introduction.

**M405:** **DISCRETE DYNAMICAL SYSTEMS**

**Course Outcomes:** The study of M.Sc. degree programme will enable the students:

1. To discuss about Phase Portraits, Periodic Points and Stable Sets, Sarkovskii’s theorem, Differentiability and its Implications.
2. To explain the concepts of Parameterized Families of Functions and Bifurcations; The Logistic Function Part I, The Logistic Function Part II Topological Conjugacy, The Logistic Function Part III and Newton’s method.
3. Be able to write and understand the basic proofs of Numerical solutions of Differential Equations, The Dynamics of Complex functions, Quadratic Family and Mandelbrot Set.

**UNIT I :** Phase Portraits, Periodic Points and Stable Sets, Sarkovskii’s theorem, Differentiability and its Implications [Hyperbolic, Attractive and Repelling Periodic Points] [Chapters 1,4,5,6]

#### UNIT II : Parameterized Families of Functions and Bifurcations; The Logistic Function Part I [Cantor

Sets], Symbolic Dynamics and Chaos.

[Chapters 7,8,9]

#### UNIT III : The Logistic Function Part II Topological Conjugacy, The Logistic Function Part III [Period

Doubling Cascade], newton’s Method

[Chapters 10,11,12]

#### UNIT IV : Numerical solutions of Differential Equations, The Dynamics of Complex functions [newton’s Method in Complex Plane], the Quadratic Family and Mandelbrot Set

[Chapters 13, 15 and Sections 14.3, 14.5]

**PRESCRIBED TEXT BOOK :** Richard M. Holmgren, A First Course in Discrete Dynamical Systems,Springer Verlag.

**REFERENCE TEXT BOOK:** Introduction to Dynamical Systems by Michael Brin and Garrett Stuck.