

**Syllabus**

For

**B.A./B.Sc. (Hons) in Mathematics**

**(Semester I & II)**

**Under NEP (2020)**

**Department of Mathematics**

**North Lakhimpur College (Autonomous)**

**Semester wise credit distribution for B.A./B.Sc. (Hons) in Mathematics under NEP (2020)**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Semester** | **Discipline Specific Core (DSC)/ Major (Core)** | **Discipline Specific Elective (DSE)/ Open Elective Course (OEC)/ Minor**  | **Multidisciplinary/ Interdisciplinary****(MDC)** | **Ability Enhancement Compulsory Courses (AECC)** | **Skill Enhancement Courses (SEC)** | **Internship** | **Value Addition Courses (VAC)/****Dissertation/Thesis** | **Research Project** | **Total** |
| I | **Paper code:** **MJ-T5-MTH-101****CREDIT: 5****(L-4, T-1, P-0)**Algebra-I | **Paper code:** **MN-T5-MTH-101****CREDIT: 5****(L-4-, T-1, P-0)**Algebra-I | **Paper code: MD-T3-MTH-101****CREDIT: 3 (L-3, T-0, P-0)**Foundation In Mathematics-I | Communicative English-I(2 Credit) | **Paper code: SE-P3-MTH-101****CREDIT: 3****(L-0, T-0, P-3)**Computer Lab-I | - | VAC –I (3 Credit) | - | 21Credit |
| II | **Paper code:** **MJ-T5-MTH-201****CREDIT: 5****(L-4, T-1, P-0)**Real Analysis-I | **Paper code:** **MN-T5-MTH-201****CREDIT: 5****(L-4, T-1, P-0)**Real Analysis-I | **Paper code: MD-T3-MTH-201****CREDIT: 3****(L-3, T-0, P-0)**Foundation In Mathematics-II | Language And Literature (Mil/Regional Language)(2 Credit) | **Paper code: SE-P3-MTH-201****CREDIT: 3****(L-0, T-0, P-3)**Programming With Mathematical Software | - | VAC –II(3credit) | - | 21Credit |

**FIRST SEMESTER**

**Discipline Specific -MAJOR Course**

**(ALGEBRA-I)**

**Paper code: MJ-T5-MTH-101**

**CREDIT: 5 (L-4, T-1, P-0)**

**Total Marks=70**

**Objectives:**: This course will enable the students to:

 CO1: Understand the importance of roots of real and complex polynomials and learn various methods of obtaining root and employ De Moivre’s theorem in a number of applications to solve numerical problems.

 CO2: Familiarize with divisibility theory & modular arithmetic of integers.

 CO3: Recognize the mathematical objects called groups; link the fundamental concepts of groups and symmetries of geometrical objects; explain the significance of the notions of subgroups, cyclic groups and their classifications.

**Unit – 1 : (Marks-30)**

**Theory of Equations and Complex Numbers**: General properties of polynomials and equations, Fundamental theorem of algebra, Relations between the roots and the coefficients, Upper bounds for the real roots; Theorems on imaginary, integral and rational roots; Newton’s method for integral roots, Descartes’ rule of signs; De-Moivre’s theorem for integer and rational indices and their applications, The nth roots of unity, Cardan’s solution of the cubic, Descartes’ solution of the quartic equation.

**Unit – 2: (Marks-15)**

**Basic Number Theory:** Division algorithm in ℤ, Divisibility and the Euclidean algorithm, Fundamental theorem of arithmetic, Modular arithmetic and basic properties of congruences.

 **Unit – 3: (Marks-25)**

**Basics of Group Theory:** Groups, Basic properties, Symmetries of a square, Dihedral group, Order of a group, Order of an element, Subgroups, Center of a group, Centralizer of an element, Cyclic groups and properties, Generators of a cyclic group, Classification of subgroups of cyclic groups.

**Reference Books:**

1. Titu Andreescu, D. Andrica, Complex numbers from A to...Z, Birkhäuser.

2. Leonard Eugene Dickson , First Course in the Theory of Equations. John Wiley & Sons, Inc.

3. Joseph. A. Gallian, Joseph. A, Contemporary Abstract Algebra , Cengage Learning India Private Limited.

4. Edgar G. Goodaire, Michael M. Parmenter, Discrete Mathematics with Graph Theory, Pearson Education Pvt. Ltd.

**SECOND SEMESTER**

**Discipline Specific -MAJOR Course**

**( REAL ANALYSIS-I)**

**Paper code: MJ-T5-MTH-201**

**CREDIT: 5 (L-4, T-1, P-0)**

**Total Marks=70**

**Objectives**:: This course will enable the students to:

CO1: Understand many properties of the real line $R$ and learn to define sequence in terms of functions from $N$ to a subset of $R$.

 CO2: Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate their limit superior, limit inferior, and the limit of a bounded sequence.

 CO3: Apply the ratio, root, alternating series and limit comparison tests for convergence and absolute convergence of an infinite series of real numbers.

**Unit-1: (Marks-25)**

Review of Algebraic and Order Properties of $R$, Equivalent sets in $R$, Idea of countable sets and uncountable sets, Uncountability of $R$, Bounded Sets, Unbounded sets, Suprema and Infima, The Completeness Property of $R$, The Archimedean Property, Intervals, neighborhood of a point in $R$, Limit points of a set, Isolated points, Derived sets, Open sets, Closed sets, Bolzano-Weierstrass theorem for sets.

**Unit-2**:  **(Marks-25)**

Sequences, Bounded sequence, Convergent, Divergent & Oscillatory sequences, Limit of a sequence. Limit Theorems, Monotone Sequences, Monotone Convergence Theorem, Sandwich theorem, Subsequences, Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cauchy’s Convergence Criterion for sequence.

**Unit-3**:  **(Marks-20)**

Infinite series, convergence and divergence of infinite series, Cauchy Criterion for series, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchy’s nth root test, Alternating series, Leibnitz test, Absolute and Conditional convergence.

**Reference Books:**

1. R.G. Bartle, D.R. Sherbert, Introduction to Real Analysis, John Wiley and Sons (Asia) Pvt. Ltd.

2. S.C. Malik, S. Arora, Mathematical Analysis, New age International (P) Ltd.

**FIRST SEMESTER**

**Discipline Specific-MINOR Course**

**( ALGEBRA-I)**

**Paper code: MN-T5-MTH-101**

**CREDIT: 5 (L-4-, T-1, P-0)**

**Total Marks=70**

**Objectives:**: This course will enable the students to:

 CO1: Understand the importance of roots of real and complex polynomials and learn various methods of obtaining root and employ De Moivre’s theorem in a number of applications to solve numerical problems.

 CO2: Familiarize with divisibility theory & modular arithmetic of integers.

 CO3: Recognize the algebraic structures called groups; explain the significance of the notions of subgroups, cyclic groups and analyse consequences of Lagrange’s theorem.

**Unit – 1: (Marks-30)**

**Theory of Equations and Complex Numbers**: General properties of polynomials and equations, Fundamental theorem of algebra, Relations between the roots and the coefficients, Upper bounds for the real roots; Theorems on imaginary, integral and rational roots; Newton’s method for integral roots, Descartes’ rule of signs; De-Moivre’s theorem for integer and rational indices and their applications, The nth roots of unity, Cardan’s solution of the cubic, Descartes’ solution of the quartic equation.

**Unit – 2 : (Marks-15)**

**Basic Number Theory:** Division algorithm in $Z$, Divisibility and the Euclidean algorithm, Fundamental theorem of arithmetic, Modular arithmetic and basic properties of congruences.

 **Unit – 3: (Marks-25)**

**Basics of Group Theory:** Binary Operations, algebraic structures, Groups, Basic properties, Order of a group, Order of an element, Subgroups, Cyclic groups, Lagrange’s theorem, Center of a group, Centralizer of an element.

**Reference Books:**

1. Titu Andreescu, D. Andrica, Complex numbers from A to...Z, Birkhäuser.

2. Leonard Eugene Dickson, First Course in the Theory of Equations. John Wiley & Sons, Inc.

3. Joseph. A. Gallian, Joseph. A, Contemporary Abstract Algebra, Cengage Learning India Private Limited.

4. Edgar G. Goodaire, Michael M. Parmenter, Discrete Mathematics with Graph Theory, Pearson Education Pvt. Ltd.

**SECOND SEMESTER**

**Discipline Specific-MINOR Course**

**( REAL ANALYSIS-I)**

**Paper code: MN-T5-MTH-201**

**CREDIT: 5 (L-4, T-1, P-0)**

**Total Marks=70**

**Objectives**:: This course will enable the students to:

 CO1: Understand many properties of the real line $R$ and learn to define sequence in terms of functions from $N$ to a subset of $R$.

 CO2: Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate their limit superior, limit inferior, and the limit of a bounded sequence.

 CO3: Apply the ratio, root, alternating series and limit comparison tests for convergence and absolute convergence of an infinite series of real numbers.

**Unit-1: (Marks-25)**

Review of Algebraic and Order Properties of $R$, Equivalent sets in $R$, Bounded Sets, Unbounded sets, Suprema and Infima, The Completeness Property of $R$, The Archimedean Property, Intervals, neighborhood of a point in $R$, Limit points of a set, Isolated points, Derived sets, Open sets, Closed sets, Bolzano-Weierstrass theorem for sets.

**Unit-2**:  **(Marks-25)**

Sequences, Bounded sequence, Convergent, Divergent & Oscillatory sequences, Limit of a sequence. Limit Theorems, Monotone Sequences, Monotone Convergence Theorem, Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cauchy’s Convergence Criterion for sequence.

**Unit-3**:  **(Marks-20)**

Infinite series, convergence and divergence of infinite series, Cauchy Criterion for series, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchy’s nth root test, Alternating series, Leibnitz test.

**Reference Books:**

1. R.G. Bartle, D.R. Sherbert, Introduction to Real Analysis, John Wiley and Sons (Asia) Pvt. Ltd.

2. S.C. Malik, S. Arora, Mathematical Analysis, New age International (P) Ltd.

**FIRST SEMESTER**

**Multidisciplinary/Interdisciplinary Course - MDC**

**(Foundation in Mathematics-I)**

**Paper code: MD-T3-MTH-101**

**CREDIT: 3 (L-3, T-0, P-0)**

**Total Marks=42**

**OBJECTIVES:** This course will enable the students to:

CO1: Learn about set theory and mathematical logic.

CO2: Familiarize with relation, binary operation and function.

CO3: Recognize determinants and matrices with applications.

**UNIT-1: Sets and Logic: (Marks-18)**

Sets, subsets, types of set, operations on sets, Cartesian product, Statements, truth values and truth table, negation, conjunction and disjunction, Statements with quantifiers, compound statements, implications, biconditional proposition, converse, contrapositive and inverse proposition, propositional equivalence, predicates and quantifier, tautology and contradiction.

**UNIT-2: Relations and functions: (Marks-12)**

Relation and functions, types of relation and functions, graphs of functions, compositions of functions and invertible function, Binary operations.

**UNIT-3: Determinants and Matrices: (Marks-12)**

Determinants and its properties, matrices and their types, algebra of matrices, elementary transformation, elementary matrices, adjoint & inverse of a matrix, solution of a linear system of equations.

**Reference Books:**

1. H.S. Hall, S.R. Knight, Higher Algebra, MacMilan and Co., limited.

2. Swapan Kr. Dey, Discrete Mathematics, S. Chand publications.

**SECOND SEMESTER**

**Multidisciplinary/Interdisciplinary Course - MDC**

**(Foundation in Mathematics-II)**

**Paper code: MD-T3-MTH-201**

**CREDIT: 3(L-3, T-0, P-0)**

**Total Marks=42**

**OBJECTIVES:** This course will enable the students to:

CO1: Learn about rank of matrices and its applications.

CO2: Find numerical solutions of system of linear equations and check the accuracy of the solutions.

CO3: Obtain numerical solutions of transcendental and polynomial equations.

**UNIT-1: Rank of matrices (Marks-14)**

Rank of matrix, Echelon form, reduced Echelon form, normal form.

Applications of rank of matrix in solving: system of linear equations, business & Economics

Problems.

**UNIT-2: System of linear algebraic equations: (Marks-14)**

System of linear algebraic equations: Gaussian elimination, Gauss Jordan method, Gauss Jacobi method, Gauss-Seidel method and their convergence analysis.

**UNIT-3: Transcendental and Polynomial equations: (Marks-14)**

Bisection method, Newton’s method, Regula falsi method, Secant method, Rate of convergence of these methods.

**Reference Books:**

1. M.K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical methods for scientific and engineering computations, New Age Intl. Publisher.
2. S.S. Sastry, Introductory methods of numerical analysis, PHI.

**FIRST SEMESTER**

**Skill Enhancement Course -SEC**

**(COMPUTER LAB-I)**

**Paper code: SE-P3-MTH-101**

**CREDIT: 3(L-0, T-0, P-3)**

**Total Marks=42**

**OBJECTIVES:** This course will enable the students to:

CO1: Understand and apply the concepts of open source mathematical software for solving mathematical problems.

**List of practical to be performed using any mathematical software:**

 **(Marks-42)**

* Basic commands and syntax.
* Evaluation of mathematical expressions.
* Solution of equations: Algebraic and transcendental equations.
* Plotting 2D and 3D graphs.
* Matrix operations.
* Tracing of conics.
* Derivatives and integrals of real functions.
* Solution of ODE.

**Reference Books:**

1. Martha L Abell, James P Braselton, Differential Equations with Mathematica, Elsevier Academic Press.
2. Rudra Pratap, Getting Started with Matlab: A quick introduction for scientist and engineers, Oxford University Press.

**SECOND SEMESTER**

**Skill Enhancement Course -SEC**

**(Programming with mathematical software)**

**Paper code: SE-P3-MTH-201**

**CREDIT: 3(L-0, T-0, P-3)**

**Total Marks=42**

**OBJECTIVES:** This course will enable the students to:

CO1: Understand and apply the concepts of open source mathematical software for solving mathematical problems.

**Programming with any mathematical software: (Contact hour- 90)**

* Logical symbols and expressions, variables, constants
* Conditional statements
* Loops: do, while, for
* Creating functions
* Programming examples: sum of series, solving equations and systems of equation using different numerical methods, checking for primes, finding perfect numbers, solution of quadratic equations, finding C.I., calculating EMI etc., finding mean, median, mode, standard deviation, mean deviation.

**Reference Books:**

1. Martha L Abell, James P Braselton, Differential Equations with Mathematica, Elsevier Academic Press.
2. Rudra Pratap, Getting started with Matlab: A quick introduction for scientists and engineers, Oxford University Press.