Semester 1

Common Course (Major/Minor)

Course Code: 1MT COC1 (Credit: 4, Lectures: 60 Hours; Full Marks: 100)

Course Name: Basic Mathematics 1

Course Outcome: This course covers basic set theory, relations, mapping. Students will explore special sets such as natural, rational, irrational, and real numbers, understanding their properties and significance. They will also delve into point set theory in the Set theory group. In Classical Algebra, students will study the concept and applications of inequalities, complex numbers, and the theory of equations. The knowledge gained in this course will be beneficial for future courses on number theory and analysis, providing students with a solid foundation to go deeper into these mathematical topics.

Course Content:

Group A (30 Hours Lecture)

Set Theory

1. Recapitulation**:** set, subset and superset, operations on sets, De Morgan's laws, cartesian product of sets.
2. Relation, equivalence relation and partial order relation, equivalence class, partition of a set, fundamental theorem on equivalence relation and partition.
3. Mapping**:** different types of mapping, composition of mapping, restriction and extension of mapping.
4. Finite and infinite sets, countable and uncountable sets, cardinality of R, Q and intervals.
5. Natural numbers, well ordering principle for N, mathematical induction – simple applications, rational numbers – examples, algebraic property, order property and density property of rational numbers, real Numbers – algebraic property and order property, point set in one-dimension, bounded set, least upper bound axiom or completeness axiom, Archimedean property and density property of real numbers.
6. Point set theory in one dimension**:** neighbourhood of a point, interior, accumulation points and isolated points. Bolzano – Weierstrass theorem for accumulation point. Union, intersection, complement of open and closed sets in R, derived set, closure of a set, deduction of basic properties of interior of a set and closure of a set.

References

1. Contemporary Abstract Algebra – Joseph A. Gallian
2. Topics in Abstract Algebra – Sen, Ghosh, Mukhopadhyay and Maity.
3. First Course in Abstract Algebra – Fraleigh.
4. Introduction to Real Analysis – Donald R. Sherbert and Robert G. Bartle
5. Mathematical Analysis – T. M. Apostol.
6. Real analysis – Goldberg.
7. Introduction to Mathematical Analysis- Amritava Gupta.

Group B (30 Hours Lecture)

Classical Algebra

1. Weierstrass' inequality, Cauchy – Schwarz inequality, arithmetic, geometric, harmonic means and weighted means and related theorems.

2. Complex numbers – definition and field structure, conjugate of a complex number, modulus of a complex number, triangle inequality, amplitude of a complex number, De Moivre's theorem, roots of a complex number, nth roots of unity, exponential and logarithm of a complex number, definition of $a^z, a \neq 0$.

3. Polynomials and polynomial equations, addition and multiplication of polynomials, statement of division algorithm, remainder theorem and factor theorem, fundamental theorem of classical algebra (statement only) and its consequences, polynomials with real co-efficient, Rolle's theorem and its applications, multiple roots, Descartes rule of signs (statement only) and its consequences, Strum's function (emphasis on problems), relation between roots and coefficients, transformation of equation, reciprocal equation, binomial equation, special roots, Cardan's method for solving cubic equations, Ferrari's method for solving bi-quadratic equations.

References

1. Higher Algebra (Classical) – S. K. Mapa.
2. Higher Algebra – Barnard & Child.
3. Introduction to Classical Algebra – Chandan Bikash Das and Pabitra Kumar Gouri
4. The Theory of Equations- Burnside and Panton