# MANGALORE UNIVERSITY

## DEPARTMENT OF MATHEMATICS

## MSC MATHEMATICS

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| **MTH 502** | **Complex Analysis - I** | **4 Credits (48 hours)** |

**Course Outcome:**Students will have the knowledge and skills to apply the theory of complex analysis course in - engineering and allied sciences. This course is a foundation for next course in Complex analysis.

**Course Specific Outcome:**

At the end of the course Students will have the knowledge and skills to understand, explain in depth and apply in various situations the concepts -

- the need for a Complex Number System
- The stereographic projection,
- Analytic functions, Sequences,
- Series, Uniform convergence, Power series.
- The exponential and trigonometric functions,
- Cauchy's theorem, Cauchy's Integral Formula,
- Removable singularities, Taylor's theorem, Zeros and poles,
- The maximum principle.

**Unit I - Complex numbers and Complex Functions:**

Recapitulation of the algebra of complex numbers - Arithmetic operations, Square roots, Conjugation, Absolute value, Inequalities.

The geometric representation of complex numbers - Geometric addition and multiplication, The binomial equation, Analytic geometry, The spherical representation.

Introduction to the concept of analytic function - Limits and continuity, Analytic functions, Polynomials, Rational functions.

Elementary theory of power series - Sequences, Series, Uniform convergence, Power series, Abel's limit theorem. The exponential and trigonometric functions - The exponential, The trigonometric functions, The periodicity, The logarithm.

**(18 Hours)**

**Unit II - Analytic Functions as Mappings, Complex Integration :**

Elementary Point set Topology - All topological properties to be reviewed, with an emphasis on Connectedness, and Compactness.

Conformality - Arcs and closed curves, Analytic functions in regions, Conformal mapping, Length and area.

Linear transformation - The linear group. The cross ratio, Symmetry.

Fundamental theorems - Line integrals, Rectifiable arcs, Line integrals as function of arcs, Cauchy's theorem for a rectangle, Cauchy's theorem for a disk.

Cauchy's Integral Formula - The index of a point with respect to a closed curve, The integral formula, Higher derivatives.

**(16 Hours)**

**Unit III - Local Properties of Analytical Functions:**

Removable singularities, Taylor's theorem, Zeros and poles, The local mapping, The maximum principle.

The General Form of Cauchy's Theorem - Chains and cycles, Simple connectivity, Homology, The general statement of Cauchy's theorem - Cauchy's theorem. Locally exact di erentials,Multiply connected regions.

**(14 Hours)**

**References**

[1] Lars V. Ahlfors, *Complex Analysis*, 3rd Ed., McGraw Hill, 1979.

[2] B. R. Ash, *Complex Variables*, 2nd Ed., Dover Publications, 2007.

[3] R. V. Churchill, J. W. Brown and R. F. Verlag, *Complex Variables and Applications*, 8th Ed., Mc Graw Hill, 2009.

[4] J. B. Conway, *Functions of one Variable*, Narosa, New Delhi, 1996.

[5] S. Ponnuswamy and H. Silverman, *Complex Variables with Applications*, Birkauser, 2006.