**DEPARTMENT OF MATHEMATICS**
**GOVERNMENT DEGREE COLLEGE BARAMULLA (AUTONOMOUS)**

**SYLLABUS FOR B.A./B.Sc. MATHEMATICS (HONORS) 7TH & 8TH SEMESTERS**
**Year 2025 AND ONWARDS**

# COMPLEX ANALYSIS-I

**Course Code:** MMTC2822M **Semester: 8th** **Total Credits: 4+2**
**Continuous Assessment: Marks 50** **Theory: Marks 100**
**Total Marks: 150** **Course hrs: 64+32**

Course Learning Outcomes (CLO's): Upon successful completion of the course, students will be able to:

CLO1. Explain analyticity of complex functions using C-R equations, and apply Cauchy–Goursat theorem, Cauchy's integral formula, Morera's theorem, and Cauchy's inequality.

CLO2. Apply Liouville's theorem, Fundamental Theorem of Algebra, Taylor's theorem, modulus principles, Schwarz lemma, Argument principle, and Rouche's theorem.

CLO3. Classify singularities via Laurent's theorem, analyze poles and essential singularities, apply Casorati-Weierstrass theorem, and study convergence of infinite products.

CLO4. Analyze Möbius transformations and conformal mappings, including mappings between discs, half-planes, circles, and special cases like $w = z^2$ and $w = 1/2\,(z + 1/z)$.

**Credit-I** Continuity and differentiability of complex functions, C-R equations and analytic functions, necessary and sufficient condition for a function to be analytic, complex integration, Cauchy Goursat theorem, Cauchy's integral formula, higher order derivatives, Morera's theorem, Cauchy's inequality.

**Credit-II** Liouville's Theorem and its generalization, fundamental theorem of algebra, Taylor's theorem, Maximum/Minimum modulus theorem, Schwarz lemma and its generalizations, zeros of an analytic function and their isolated character, identity theorem, Argument principle, Rouche's theorem and its applications.

**Credit-III** Laurant's theorem, classification of singularities, removable singularity, Riemann's theorem, poles and behaviour of a function at a pole, essential singularity, Casorati-Weiersstras theorem on essential singularity. Infinite products, convergence and divergence of infinite product, absolute convergence, necessary and sufficient conditions for convergence and absolute convergence.

**Members:**
**1. Prof. Tariq Ahmad Chishti** _____ **2. Prof Tariq Ahmad Chalkoo** _____

**3. Dr. Tariq Ahmad Naikoo** _____ **4. Dr. Nisar Ahmad Lone** _____

**5. Dr. Farooq Ahmad Sheikh** _____ **6. Dr. Shahnawaz Ahmad Rather** _____

*Dr. Mahnaz Shafi Chishti*
*(Chairperson/Member)*

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**Credit-IV** Möbius transformation: Definition, examples, properties and classification, fixed points, cross ratio, inverse points and critical points, conformal mapping, linear transformations carry circles to circles and inverse points to inverse points, mappings of (i) upper half plane on to the unit disc, (ii) unit disc on to the unit disc, (iii) left half plane on to the unit disc and (iv) circle on to a circle. The transformation $w = z^2$ and $w = 1/2\,(z + 1/z)$.

**Tutorials:**

**Credit-I** Problem-solving on continuity, differentiability, and analyticity of complex functions using Cauchy-Riemann equations. Exercises include applications of Cauchy's theorems, integral formula, Liouville's theorem, maximum and minimum modulus theorems, and Schwarz lemma.

**Credit-II** Practice on classification of singularities, Laurent series, and residue evaluation for complex integrals. Problems on poles and essential singularities, Casorati-Weierstrass theorem, convergence of infinite products, and Möbius transformations with fixed points, cross ratios, and geometric mappings between standard domains.

**Recommended Books:**


1. L. Ahlfors, Complex Analysis, Mc Graw Hill, 2000.
2. J. B. Conway, Functions of a Complex Variable - I, Springer 2nd Edition 7th Printing, 1995.
3. Richard Silverman, Complex Analysis, Dover Publications Inc., 1984.
4. H. A. Priestley, Introduction to Complex Analysis, Oxford University Press, 2008.
5. Z. Nehari, Conformal Mappings, Dover Publications Inc., 2003.


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