2-Year Master's Program in Mathematics (NEP-2020)

COMPLEX ANALYSIS

Masters Mathematics (2nd Semester) Total Credits: 04
Course Code: MMTHCCA226 (15 hours per credit) Total Marks: 100
Continuous Assessment: Marks 30, Theory: Marks 70 Time Duration: 2½ hrs

Course Learning Outcomes (CLO's): After completion of this course, students shall be able to:

CLO1. Understand the concepts of analyticity, Cauchy-Riemann equations, and complex integration.

CLO2. Apply the fundamental theorems of complex analysis like Cauchy's, Liouville's, and Rouche's theorems.

CLO3. Classify singularities and analyze the behavior of complex functions using Laurent series and infinite products.

CLO4. Explore and apply conformal mappings and Möbius transformations in geometric function theory.

UNIT -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.

UNIT -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.

UNIT -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.

UNIT -IV

Mobius 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 $w = 1/2(z + 1/z)$.

CLO-PLO Mapping Matrix (Strength version)

CLO ↓ PLO →	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	Average CLO
MMTHCCA226.1	3	2	3	2	3	2	3	3	**2.63**
MMTHCCA226.2	3	3	3	3	3	3	2	3	**2.87**
MMTHCCA226.3	3	1	3	2	3	3	2	3	**2.5**
MMTHCCA226.4	3	3	3	2	3	3	3	3	**2.87**
Average PLO	**3**	**2.25**	**3**	**2.25**	**3**	**2.75**	**2.5**	**3**	**2.72**

Recommended Books:

1. L. V. Ahlfors**,** Complex Analysis (3rd Edition), McGraw-Hill Education, 1979.
2. S. Ponnusamy**,** Foundations of Complex Analysis (2nd Edition), Narosa Publishing House, 2005.
3. Zeev Nehari**,** Conformal Mapping, Dover Publications, 2012.
4. Richard A. Silverman**,** Complex Analysis with Applications, Dover Publications, 1984.
5. John B. Conway**,** Functions of One Complex Variable *I* (2nd Edition), Graduate Texts in Mathematics, Vol. 11, Springer, 1978.