Subject Code: 02MA0401

Subject Name: COMPLEX ANALYSIS

M.Sc. Year – I (Sem-1)

Objective: The main aim is to make students familiar with complex numbers, their properties and Calculus of functions of complex variables.

Credits Earned: 5 Credits

Course Outcomes: After completion of this course, student will be able to

- Generalize the concept of functions, limits, continuity, differentiability and analyticity in complex variables.
- Understand and apply the knowledge of elementary functions and harmonic functions.
- Evaluate contour integrals, Generalize the idea of series expansions at the singular points by Laurent's series and use it in complex integrations.
- Classify zeros and singularities of complex functions.
- Understand and apply conformal mapping and harmonic function theory in the solutions of problem in fluid flow
- Graph the images of complex mappings.

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	Mid Sem (M)	Internal (I)	Viva (V)	Term work (TW)	
4	2	-	5	50	30	20	25	25	150

Contents:

Unit	Topics	Contact Hours
1	**Complex Numbers, Functions of complex variables** Basic algebraic properties, Vectors and Modulli, Complex conjugates, Exponential form, n^{th} Roots of complex numbers, Regions in complex plane, Functions of complex variables, Limits, Continuity and Differentiability, Cauchy-Riemann equations, Analytic functions, Harmonic functions and their conjugates, Reflection principle, Elementary functions.	**12**

2	**Complex Integration:** Definite integrals of functions of real variable, Contours, Line integral, Branch cuts, ML-inequality, Simply and Multiply connected domains, Cauchy-Goursat theorem. Cauchy-Integral formula, Generalized Cauchy-Integral formula, Liouville's theorem, Fundamental theorem of algebra, Maximum modulus principle	14
3	**Series, Singularities and Residues:** Convergence of Sequences and Series, Taylor's Theorem, Laurent's Series, Absolute and Uniform Convergence of Power Series, Differentiation and Integration of Power series, Uniqueness of Series Representation, Classification of Singular points, Residues at isolated singular points ,Zeros of Analytic functions, Behaviour of functions near singular points.	14
4	**Cauchy Residue Theorem and its applications:** Cauchy's Residue Theorem, Evaluation of Integrals involving sine and cosine functions, Evaluation of Improper Integrals, An indentation around a branch point, Argument principle, Rouche's Theorem	13
5	**Mapping by Elementary Functions and Conformal Mapping** Linear Transformations, Bilinear (Linear fractional) transformations, Mappings by some standard transformations**,** Preservation of Angles, Scale Factors	7
	Total Hours	60

Recommended Books:

1. 'Complex variables and Applications', James Ward Brown and Ruel V. Churchill, McGraw-Hill, Inc. 1996.

2. Functions of One Complex Variable, John B. Conway, Narosa Publishing house, 2002.

3. Foundations of Complex Analysis, Saminathan Ponnusamy, Narosa Publishing house, 2005.

4. Complex Variables (Theory and applications), Harvir S. Kasana, Prentice-Hall of India Pvt. Ltd., 2006.

5. Introduction to Functions of Complex Variable, Curtiss, J.Hamilton, Marcel Dekker inc. , Newyork, 1978.

6. Complex Analysis, David Tall and Ian Stewart, Cambridge University Press, 1984.

7. The Elements of Complex Analysis, Duncan J.C., John Wiley & Sons, London, 1968.

Suggested Theory distribution:

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
20%	20%	30%	15%	10%	5%

Instructional Method:

a. The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

b. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.

c. Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

d. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory.

Supplementary Resources:
1. http://en.wikipedia.org/wiki/Complex_analysis
2. http://people.math.gatech.edu/~cain/winter99/complex.html
3. http://people.math.gatech.edu/~cain/winter99/complex.html
4. http://mathworld.wolfram.com/ComplexAnalysis.html
5. http://mathworld.wolfram.com/ComplexDifferentiable.html