ARSD College, University of Delhi

Model Course Handout/Lesson Plan

Course Name : B.Sc. (H) Mathematics						
Semester	**Course Code**	**Course Title**	**Lecture (L)**	**Tutorial (T)**	**Practical (P)**	**Credit (C)**
6th		Complex Analysis	4		4	6
Teacher/Instructor(s)		Amit Kumar				
Session		2021-22				

Course Objective: This course aims to introduce the basic ideas of analysis for complex functions in complex variables with visualization through relevant practicals. Emphasis has been laid on Cauchy's theorems, series expansions and calculation of residues.

Course Learning Outcomes: The completion of the course will enable the students to:

i) Learn the significance of differentiability of complex functions leading to the understanding of Cauchy−Riemann equations.
ii) ii) Learn some elementary functions and valuate the contour integrals.
iii) iii) Understand the role of Cauchy−Goursat theorem and the Cauchy integral formula.
iv) iv) Expand some simple functions as their Taylor and Laurent series, classify the nature of singularities, find residues and apply Cauchy Residue theorem to evaluate integrals.

Lesson Plan:

Unit No.	Learning Objective	Lecture No.	Topics to be covered
1.	Analytic Functions and Cauchy−Riemann Equations	1-4	Functions of complex variable, Mappings; Mappings by the exponential function
		5-7	Limits, Theorems on limits, Limits involving the point at infinity
		8-11	Continuity, Derivatives, Differentiation formulae, Cauchy−Riemann equations
		12-16	Sufficient conditions for differentiability; Analytic functions and their examples.
2.	Elementary Functions and Integrals	17-19	Exponential function, Logarithmic function, Branches and derivatives of logarithms
		20-23	Trigonometric function, Derivatives of functions,

			Definite integrals of functions
		24-26	Contours, Contour integrals and its examples
		27-28	Upper bounds for moduli of contour integrals,
3.	Cauchy's Theorems and Fundamental Theorem of Algebra	29-32	Antiderivatives, Proof of antiderivative theorem, Cauchy−Goursat theorem
		33-35	Cauchy integral formula; An extension of Cauchy integral formula
		36-40	Consequences of Cauchy integral formula, Liouville's theorem and the fundamental theorem of algebra.
4.	Series and Residues	41-42	Convergence of sequences and series
		43-45	Taylor series and its examples; Laurent series and its examples
		46-47	Absolute and uniform convergence of power series
		48-49	Uniqueness of series representations of power series,
		50-52	Isolated singular points, Residues, Cauchy's residue theorem
		53-54	residue at infinity; Types of isolated singular points,
		55-56	Residues at poles and its examples.

Evaluation Scheme:

No.	Component	Duration	Marks
1.	Internal Assessment		25
	• Quiz		
	• Class Test		
	• Attendance		
	• Assignment		
2.	End Semester Examination	3 hr	75

Details of the Course		
Unit	**Contents**	**Contact Hours**
1	**Analytic Functions and Cauchy−Riemann Equations** Functions of complex variable, Mappings; Mappings by the exponential function, Limits, Theorems on limits, Limits involving the point at infinity, Continuity, Derivatives, Differentiation formulae, Cauchy−Riemann equations, Sufficient conditions for differentiability; Analytic functions and their examples.	16
2	**Elementary Functions and Integrals** Exponential function, Logarithmic function, Branches and derivatives of logarithms, Trigonometric function, Derivatives of functions, Definite integrals of functions, Contours, Contour integrals and its examples, Upper bounds for moduli of contour integrals.	12

3	**Cauchy's Theorems and Fundamental Theorem of Algebra** Antiderivatives, Proof of antiderivative theorem, Cauchy−Goursat theorem, Cauchy integral formula; An extension of Cauchy integral formula, Consequences of Cauchy integral formula, Liouville's theorem and the fundamental theorem of algebra.	12
4	**Series and Residues** Convergence of sequences and series, Taylor series and its examples; Laurent series and its examples, Absolute and uniform convergence of power series, Uniqueness of series representations of power series, Isolated singular points, Residues, Cauchy's residue theorem, residue at infinity; Types of isolated singular points, Residues at poles and its examples.	16
	Total	**56**

Suggested Books:

Sl. No.	**Name of Authors/Books/Publishers**	**Year of Publication/Reprint**
1	Brown, James Ward, & Churchill, Ruel V. (2014). Complex Variables and Applications (9th ed.). McGraw-Hill Education. New York.	2014

Mode of Evaluation:	Internal Assessment / End Semester Exam