

Complex Analysis - Web course

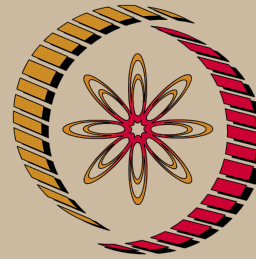
COURSE OUTLINE

The course will cover the following

- i. Basic ideas of functions of one complex variable
- ii. Introduction to the concept of analytic functions and harmonic functions. Elementary functions of complex variable with their properties
- iii. Complex integration and its deduction leading to Taylor's and Laurent's series
- iv. Theory of residues and its application to evaluate various integrals
- v. Conformal mapping and bilinear transformation and its application to some engineering problems.

COURSE DETAIL

Unit No.	Topic/s	Lectures
1	Definition of Complex number and the Algebra of Complex Numbers – conjugation – absolute value – inequalities.	2
2	Functions of a complex variable – limits – continuity – uniform continuity – differentiability – analytic function – C-R equations – necessary and sufficient conditions - applications to the problems of potential flow – Harmonic functions –	6



NP-TEL

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<http://nptel.ac.in>

Mathematics

Pre-requisites:

First course on Calculus consisting of differential calculus, integral calculus and differential equations

Additional Reading:

1. Complex Variables, Murray R Spiegel, Schaum's Outlines, Tata McGraw Hill, 1981.

Hyperlinks:

http://en.wikipedia.org/wiki/Complex_analysis

Coordinators:

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	Harmonic conjugates – Milne’s method.		
3	Sequences – Series – Uniform convergence – power series – Hadamard’s formula for the radius of convergence – elementary functions – exponential, trigonometric and hyperbolic functions and their identities in the complex plane – multiple valued functions – logarithmic functions and functions with complex exponent.	4	
4	Complex integration - rectifiable arcs – contours – complex line integration – Cauchy’s theorem – Cauchy’s integral formula for the derivatives of an analytic function- Cauchy’s estimate – Morera’s theorem – Liouville’s theorem – Fundamental theorem of Algebra.	4	
5	Maximum modulus principle – Schwarz lemma – Taylor series – Laurent series – Zeros and poles of a function – meromorphic function.	5	
6	The residue at a singularity – Residue theorem – the argument principle – Rouché’s theorem – contour integration and its applications – improper integrals – evaluation of a real integral – improper integrals involving sines and cosines – definite integrals involving sines and cosines – integration through branch cut.	5	

7	Definition of conformal mapping – Bilinear transformation – Cross ratio – the mappings from disc to disc, disc to half plane and half plane to half plane	3
8	Mapping of elementary transformations – the function $1/z$ – the function z^2 – the function $z^{1/2}$ – the transformation $w=\exp z$ – the transformation $w=\sin z$.	4
9	Applications of conformal mapping to steady temperature – electrostatic potential – two-dimensional fluid flow – stream function.	3
10	Schwarz-Christoffel transformation and their applications, Poisson formula, Dirichlet problem in the unit disc, Dirichlet problem in the half plane - Neumann problem for the disc and the half plane.	6

References:

1. Brown J.A. and Churchill R.V., Complex Variables and Applications, 6th edition, McGraw Hill, 1996.
2. Kreyszig E., Advanced Engineering Mathematics, John Wiley and Sons, 1999.