16HS201 COMPLEX VARIABLES AND TRANSFORMATIONS

Hours Per Week :

L	T	P	C
3	1	-	4

Course Description and Objectives:

In this course students will learn complex numbers, complex functions, analytic functions, complex integration and theory of residues. Laplace transformations and Z-transformations will be dealt with including applications. The objective of this course is to offer theory of complex functions, Laplace transformations, their inverses, Z-transformations and their applications.

Course Outcomes:

Upon successful completion of this course, students should be able to:

CO1: Apply the concept of Laplace transforms and solve differential equations.

CO2: Apply the concept of Z- transforms and evaluate the difference equations.

CO3: Understanding the concept of Analytical function and to construct the harmonic conjugate of the function.

CO4: Understand the concept of elementary function and evaluate complex integral using Cauchy's theorem and formula.

CO5: Evaluating Integral by using the concept of Residues.

CO6: Applications of Residue Theorem.

UNIT - 1 **L-9,T-3**

LAPLACE TRANSFORMATIONS: Introduction, Properties, Standard transformations, Change of scale property, Shifting properties, Laplace transformation of derivative and integral, Multiplication and division by *t*, Initial and final value theorems, Convolution theorem, Inverse Laplace transformations, Properties, Partial fractions method, Convolution, Applications, Solving ordinary differential equations using Laplace transformations.

UNIT - 2 **L-9,T-3**

Z – TRANSFORMATIONS: Introduction, Definition, Standard Z-transformations, Linear property, Damping rule, Shifting rules, Multiplication and division by *n*, Initial and final value theorems, Inverse Z-transformations, Convolution theorem, Applications to difference equations.

UNIT - 3 **L-9,T-3**

ANALYTICAL FUNCTIONS: Complex numbers, Properties including roots of a complex number, (Brief discussion), Functions of complex variables, Limit and continuity, Differentiability, Analytic functions, Cauchy-Riemann equations (without proof), Cauchy-Riemann equations in polar form (without proof), Orthogonal curve, Harmonic functions, Conjugate harmonic functions, Construction of conjugate harmonic function, Milne Thomson method.

UNIT - 4 **L-9,T-3**

ELEMENTARY FUNCTIONS AND COMPLEX INTEGRATION: Complex trigonometric functions, Hyperbolic functions, Relation between trigonometric and hyperbolic functions, Separation of real and imaginary parts of trigonometric and hyperbolic functions, Logarithmic function, Inverse functions, Line integral, Properties of contour integrals, Cauchy's integral theorem, Cauchy integral formula and its generalization, Evaluation of integrals.

UNIT - 5 **L-9,T-3**

RESIDUES: Convergence of series of complex terms, Power series, Region and radius of convergence, Taylor series, Maclaurin series and laurent series, Singularity, Classification of singularities, Pole at infinity, Zeros of analytic function, Residue of a pole, Residue at infinity, Residue theorem, Method of finding residues, Residue integrals.

TEXT BOOKS:

1. H. K. Dass and Er. Rajanish Verma, "Higher Engineering Mathematics", 3rd edition, S. Chand & Co, 2014.
2. B. S. Grawel, "Higher Engineering Mathematics", Khanna Publishers, 44th edition, 2014.

REFERENCE BOOKS:

1. Srimanta Pal, Subodh C and Bhunia, "Engineering Mathematics", Oxford Publications, 2015.
2. B.V. Ramana, "Higher Engineering Mathematics", 3rd edition, Tata McGraw-Hill Publishing Co, 2008.
3. R K Jain, S R K Iyengar, "Advanced Engineering Mathematics", 2nd edition, Narosa Publishing House, 2006.