BAPATLA ENGINEERING COLLEGE:: BAPATLA
(Autonomous)

COMPLEX VARIABLES AND SPECIAL FUNCTIONS
II B.Tech.IV Semester20EI401/MA04

Lectures	:	2 Hours/Week	Tutorial	:	1 Hour/Week	Practical	:	0
CIE Marks	:	30	SEE Marks	:	70	Credits	:	3

Pre-Requisite: None

Course Objectives: Students will learn how to

➢	Perceive the importance of acquiring sufficient knowledge on underlying principles of complex analysis and their prominent roles in various applications of numerous concepts.
➢	Determine Taylor and Laurent series expansions of the given functions and utilize residue concept to evaluate many difficult real integrals.
➢	Apply the ideas of Fourier Integrals, Fourier Transforms and their Inverses for addressing the real world problems in an effective manner.
➢	Analyze the properties of Special Functions for the empirical principles of effect hierarchy in recurrence relations and obtain the relevant Series Solutions for differential equations in different cases to overcome the challenging circumstances.

Course Outcomes: After studying this course, the students will be able to

CO-1	Make use of fundamentals of Complex Analysis like n roots of Complex number, Analytic Function, Continuity, Harmonic Conjugates and their important role of applicability in various concepts.
CO-2	Evaluate certain complicated real integrals under Contour integration using residue calculus and also derive the series expansions of given functions by Taylor series and Laurent Series.
CO-3	Utilize various properties and applications of Fourier transforms, their inverses including Convolution Theorem in handling scientific and technical applications.
CO-4	Identifythe meaningful Series Solutions for Differential Equations and analyze the Properties of Special Functions in solving specific engineering problems.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	3	2	-	-	-	-	-	-	-	-	3	-	2	-
CO-2	3	3	2	-	-	-	-	-	-	-	-	2	-	2	-
CO-3	3	3	2	-	-	-	-	-	-	-	-	3	-	2	-
CO-4	3	3	2	-	-	-	-	-	-	-	-	2	-	2	-

UNIT-1 (12 Hours)

Complex Numbers and functions: Complex Numbers; Geometric Representation of Imaginary numbers; Roots of a complex number; Complex function; Real and imaginary parts of circular and hyperbolic functions; **Calculus of complex functions:**Introduction; Limit of a complex

function; Derivative of f(z); Analytic functions; Harmonic functions; Complex integration; Cauchy's theorem; Cauchy's integral formula. [Sections: 19.1; 19.2; 19.5; 19.7; 19.12; 20.1; 20.2; 20.3; 20.4; 20.5;20.12; 20.13; 20.14]	
UNIT-2	(12 Hours)
Calculus of complex functions: Series of complex terms; Taylor series; Laurent's series; Zeros of an analytic function; Singularities of an analytic function; Residues; Residue theorem; Calculation of residues; Evaluation of real definite integrals: Evaluation around the unit circle, Evaluation around a small semi-circle. [Sections: 20.16.1; 20.16.2; 20.16.3; 20.17.1; 20.17.2; 20.18.1; 20.18.2; 20.19; 20.20]	
UNIT-3	(12 Hours)
Fourier transforms: Introduction; Definition; Fourier integral theorem (without proof); Fourier sine and cosine integrals; Complex form of Fourier integrals; Fourier integral representation of a function; Fourier transforms ; Properties of Fourier transforms; Convolution theorem(without proof); Fourier transforms of the derivative of a function. [Sections: 22.1; 22.2; 22.3.1; 22.3.3; 22.3.4; 22.4; 22.5; 22.6.2; 22.9] .	
UNIT-4	(12 Hours)
Series Solution of Differential Equations and Special Functions: Introduction; Validity of series solution; Series solution when x = 0 is ordinary point of the equation; Frobenius method; Bessel's function; recurrence formula for $J_n(x)$; expansions for J_0 and J_1; value of $J_{1/2}$; generating function for $J_n(x)$; Orthogonality of Bessel functions. [Sections: 16.1;16.2;16.3;16.4;16.5,16.6;16.7;16.8;16.9;16.11]	
Text Books :	B.S.Grewal, "Higher Engineering Mathematics", 44thedition, Khanna publishers, 2017.
References :	[1].Erwin Kreyszig, "Advanced Engineering Mathematics", 9th edition, John Wiley & Sons. [2].P.Bali and M.Goyal,"A Text book of Engineering Mathematics" Laxmi Publications, 2010.