COMPLEX VARIABLES & PARTIAL DIFFERENTIAL EQUAITONS
(Common to ECE and EEE)

23MA1108 **Credits:3**

Instruction : 3 periods & 1 Tutorial/Week Sessional Marks:40
End Exam : 3 Hours End Exam Marks:60

Prerequisites: Complex numbers, Differentiation, Integration and functions.

Course Objectives:

The aim of this course is to study the techniques of complex variables and functions together with their derivatives, contour integration and provide the foundations of curve fitting, correlation and regression analysis.

Course Outcomes: At the end of the course, students will be able to

1	Analyze limit, continuity and differentiation of functions of complex variables and understand Cauchy-Riemann equations, analytic functions and various properties of analytic functions.
2	Use of Cauchy's theorem, Cauchy's integral and Cauchy's residue theorems and apply these in evaluation of complex contour integrals and able to represent the given functions as Taylor's and Laurent's series, and determine their intervals of convergence. Also, understand the concepts of singularities, residues and evaluation of improper integrals by using residues.
3	Construct partial differential equation of a given equation and solve first order partial differential equations and their applications.
4	Familiar with numerical solution of ordinary differential equations.
5	Evaluate simple correlation between the two variables and fit curves by the method of least square approximation.

CO-PO –PSO Mapping:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2										1			
CO2	3	2										1			
CO3	3	2										1			
CO4	3	2										1			
CO5	3.	2										1			

Correlation levels 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping of Course Outcomes with Program Outcomes &Program Specific Outcomes:

CO-PO-PSO Justification	
1	CO1 deals with properties of analytic functions and finding analytic functions, these are widely used in many areas of engineering.
2	CO2 deals with finding the values of complex contour integration and series representation of a given complex function by using Taylor's and Laurent's series, and these are used in various fields of engineering.
3	CO3 deals with formation, finding solution and applications of PDE and there are widely used in various fields of engineering.
4	CO4 deals with finding the numerical solution of a given IVP problems.
5	CO 5 deals with the knowledge of curve fitting is widely used as an aid for data visualization and regression is to summarize the relationship among two or more variables.

SYLLABUS

UNIT I **10 Periods**

FUNCTIONS OF A COMPLEX VARIABLE

Complex function – Real and Imaginary parts of complex function – Limit – Continuity and derivative of a complex function – Cauchy-Riemann equations – Analytic function, entire function, singular point, conjugate function – Cauchy-Riemann equations in polar form – Harmonic functions – Milne-Thomson method – Simple applications to flow problems – Applications to flow problems.

UNIT II **10 Periods**

COMPLEX INTEGRATION, SERIES OF COMPLEX TERMS AND RESIDUES

Complex integration – Cauchy's theorem – Cauchy's integral formula – Series of complex terms: Taylor's series – Maclaurin's series expansion – Laurent's series – Singularities – Residues – Calculation of residues – Cauchy's residue theorem. (All theorems without proofs)

Evaluation of real definite integrals: Integration around the unit circle – Integration around a semicircle.

UNIT III **10 Periods**

PARTIAL DIFFERENTIAL EQUATIONS AND ITS APPLICATIONS

Introduction – Formation of partial differential equations by eliminating arbitrary constants and functions – Solutions of a partial differential equations by direct Integration – Linear equations the first order (Lagrange's linear equations).

APPLICATIONS : Method of separation of variables – Vibrations of a stretched string: Wave equation – One dimensional heat flow equation ($\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$), and two dimensional heat flow equation. (i.e. Laplace equation : $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$).

UNIT IV **10 Periods**

NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS

Picard's method – Taylor's series method – Euler's method, Runge - Kutta method, Predictor - Corrector methods : Milne's method,

UNIT V **10 Periods**

CORRELATION, REGRESSION ANALYSIS AND CURVE FITTING

Correlation : Definition – Karl pearson's coefficient of correlation – Measures of correlation – Rank correlation coefficients.

Regression : Simple linear regression – Regression lines and properties.

Curve Fitting : Principle of least squares – Method of least squares – Fitting of straight lines – Fitting of second degree curves and exponential curves.

TEXT BOOKS:

B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.

REFERENCE BOOKS:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.

2. N. P. Bali, Engineering Mathematics, Lakshmi Publications.

3. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas, Calculus, 13/e, Pearson Publishers, 2013.

4. H. K. Dass, Advanced Engineering Mathematics, S. Chand and complany Pvt. Ltd.

5. Michael Greenberg, Advanced Engineering Mathematics, Pearson, Second Edition.