INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

COMPLEX ANALYSIS AND SPECIAL FUNCTIONS								
III Semester: ECE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AHSD12	**Foundation**	3	1	-	4	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Basic Principles of Algebra and Calculus								

I. COURSE OVERVIEW:
The course focuses on more advanced Engineering Mathematics topics which provide with the relevant mathematical tools required in the analysis of problems in engineering and scientific professions. The course includes complex functions and differentiation, complex integration, power series expansion of complex function and special functions. The mathematical skills derived from this course form a necessary base to analytical and design concepts encountered in the program.

II. COURSES OBJECTIVES:
The students will try to learn

I. The applications of complex variable in two dimensional complex potential theories.
II. The fundamental calculus theorems and criteria for the independent path on contour integral used inproblems of engineering.
III. The concepts of special functions and its application for solving the partial differential equation inmathematical physics and engineering.
IV. The mathematics of combinatorial enumeration by using generating functions and Complex analysis forunderstanding the numerical growth rates.

III. COURSE OUTCOMES:
At the end of the course students should be able to:

CO 1	Identify the fundamental concepts of analyticity and differentiability for finding complex conjugates of complex transformations.
CO 2	Apply integral theorems of complex analysis and its consequences for the analytic function with derivatives of all orders in simple connected region.
CO 3	Extend the Taylor and Laurent series for expressing the function in terms of complex power series.
CO 4	Apply Residue theorem for computing definite integrals by using the singularities and poles of real and complex analytic functions over closed curves.
CO 5	Determine the characteristics of special functions for obtaining the proper and improper integrals for obtaining the proper and improper integrals
CO 6	Apply the role of Bessel functions in the process of obtaining the series solutions for second order differential equation.

IV. COURSE CONTENT:
MODULE-I: FUNCTIONS OF A COMPLEX VARIABLE (10)
Functions of a complex variable; concept of limits, continuity and differentiability of complex function, analyticity, Cauchy-Riemann equations (without proof); harmonic functions, constructions of analytic function, Milne-Thomson method.

MODULE-II: COMPLEX INTEGRATION (10)

Line integral: Evaluation along a path and by indefinite integration; Cauchy's integral theorem; Cauchy's integral formula; generalised Cauchy integral formula.

MODULE-III: POWER SERIES OF COMPLEX FUNCTIONS (09)
Expansion of the complex function in Taylor's series, Maclaurin's series and Laurent's series (all theorems without proof); Singularities.

Residues: Cauchy Residue Theorem (without proof); Evaluation of integrals of the type $\int_0^{2\pi} f(Cos\theta, Sin\theta)d\theta$ by residues.

MODULE-IV: SPECIAL FUNCTIONS-I (09)
Improper integrals; Beta and Gamma functions: Definitions; Properties of Beta and Gamma function; Standard forms of Beta functions; Relationship between Beta and Gamma functions.

MODULE-V: SPECIAL FUNCTIONS-II (10)
Bessel's Differential equation and its solution (without proof), Bessel function, properties of Bessel function, Recurrence relations of Bessel function, generating function and Orthogonality of Bessel function, Trigonometric expansions involving Bessel function.

V. TEXT BOOKS:

1. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2014.

VI. REFERENCE BOOKS:

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/ed, Narosa Publications, 5th edition, 2016.
2. Peter O'Neil, Advanced Engineering Mathematics, Cengage Learning.
3. B.V. Ramana, Higher Engineering Mathematics, McGraw Hill Education.
4. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint,2008.

VII. ELECTRONICS RESOURCES:

1. http://www.efunda.com/math/math_home/math.cfm
2. http://www.ocw.mit.edu/resourcs/#Mathematics
3. http://www.sosmath.com
4. http://www.mathworld.wolfram.comhttp://www.mathworld.wolfram.com

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Definition and terminology
4. Tech-talk topics
5. Assignments
6. Model question paper - I
7. Model question paper - II
8. Lecture notes
9. Early learning readiness videos (ELRV)
10. Power point presentations