INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTION FORMS

Course Title	**MATHEMATICS – III**			
Course Code	**A30007**			
Regulation	**R15 – JNTUH**			
Course Structure	**Lectures**	**Tutorials**	**Practicals**	**Credits**
	4	**1**	**0**	**4**
Course Coordinator	Mr. G. Nagendra Kumar, Assistant Professor			
Team of Instructors	Mr. G. Nagendra Kumar, Assistant Professor			

I. COURSE OVERIEW

The course matter is divided into 5 chapters covering duly-recognized areas of theory and study. This Course develops abstract and critical reasoning by studying linear ODE's and complex analysis. The course covers the basic principles (both theory and applications) of differentiable complex-valued functions of a single complex variable. Topics include the complex number system, Cauchy-Riemann conditions, analytic functions and their properties, special analytic functions including linear fractional transformations, roots, exponential, Log, trigonometric and hyperbolic functions of a complex variable; Complex integration and line integrals, Cauchy's theorem, Cauchy representation, conformal mapping, Taylor and Laurent Series expansions; the calculus of residues and various applications.

II. PREREQUISITE(S):

Level	Credits	Periods	Prerequisite
UG	**4**	**5**	Basic Calculus

III. COURSE ASSESSMENT METHODS:

a) Marks distribution:

Session Marks	University End Exam Marks	Total Marks
There shall be two mid tem examinations. Each id term exam consists of subjective type and objective type test. The subjective test is for 10 marks, with duration of 1 hour. Subjective test of each semester shall contain four questions; the student has to answer two out of them. Each carrying 5 marks. The objective test paper Is prepared by JNTUH, which consists of 20 questions each carrying 0.5 marks and total of 10 marks. The student is assessed by giving two assignments, one, after completion of 1to 4 units and the second, after the completion of 4 to 8 units each carrying 5 marks. On the total the internal marks are 25. The average of two internal tests is the final internal marks. The external question paper is set by JNTUH consisting of 8 questions each carrying 15 marks out of which 5 questions are to be answered their by external examination is of total 75 mark	75	100

IV. EVALUATION SCHEME:

S. No	Component	Duration	Marks
1	I Mid Examination	90 minutes	20
2	I Assignment	--	05
3	II Mid Examination	90 minutes	20
4	II Assignment	--	05
5	External Examination	3 hours	75

V. COURSE OBJECTIVE:

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

1. Solve series solutions, and understand special functions and its properties.
2. Evaluate differentiation and integration of complex functions and analyse conformal mapping.
3. Evaluate power series expansion of complex functions and contour integration.

VI. COURSE OUTCOMES:

After completing this course the student must demonstrate the knowledge and ability to:

1. Solve Cauchy's and Legendre's differential equations.
2. Identify ordinary points, singular points and regular singular points for the given ODE.
3. Determine the solution of ordinary differential equations in series form, Frobenius method to obtain a series solution for the given linear ODE.
4. Analyze Bessel equation and Legendre equation and their properties.
5. Identify the conditions for a complex variable function to be analytic and/or harmonic.
6. Evaluate line integral and applying Cauchy's integral theorem.
7. Solve the Taylor's and Laurent series expansion of complex functions
8. Define singularities of a function; know the different types of singularities.
9. Evaluate poles, residues and solve integrals using residue theorem.
10. Evaluate real definite integral, indefinite integral using contour integration.
11. Explain the concept of transformation in a complex space and sketch associated diagrams.
12. Analyze the properties of bilinear transformation.

VII. HOW PROGRAM OUTCOMES ARE ASSESSED

Program Outcomes		Level	Proficiency Assessed By
PO1	**Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	H	Assignments
PO2	**Problem Analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	S	Exercise
PO3	**Design / Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	H	Projects
PO4	**Conduct Investigations of Complex Problems**: Use research-based	N	-------

	knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.		
PO5	**Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	S	Discussion, Seminars
PO6	**The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	S	Exercise
PO7	**Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	H	Discussion, Seminars
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	S	Discussions
PO9	**Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	S	Discussions
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	S	Discussion, Seminars
PO11	**Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	S	Discussions, Seminars
PO12	**Life - Long Learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	S	Prototype, discussions

N= None **S=Supportive** **H=highly related**

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Level	Proficiency Assessed By
PSO1	**Professional Skills:** Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	S	Lectures, Assignments
PSO2	**Problem - Solving Skills:** Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	N	------
PSO3	**Successful Career and Entrepreneurship:** The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test , maintain power system and applications.	S	Lectures, Assignments

IX. SYLLABUS:

UNIT - I

Linear ODE with variable coefficients and series solutions (second order only):

Equations reducible to constant coefficients - Cauchy's and Lagrange's differential equations. Motivation for series solutions, Ordinary point and Regular singular point of a differential equation , Transformation of non-zero singular point to zero singular point. Series solutions to differential equations around zero, Frobenius Method about zero.

UNIT - II

Special Functions:

Legendre's Differential equation, General solution of Legendre's equation, Legendre polynomials Properties: Rodrigue's formula – Recurrence relations, generating function of Legendre's polynomials – Orthogonality. Bessel's Differential equation, Bessel functions properties: – Recurrence relations, Orthogonality, Generating function, Trigonometric expansions involving Bessel functions.

UNIT - III

Complex Functions –Differentiation and Integration:

Complex functions and its representation on Argand plane, Concepts of limit Continuity, Differentiability, Analyticity, Cauchy-Riemann conditions, Harmonic functions– Milne – Thompson method. Line integral – Evaluation along a path and by indefinite integration – Cauchy's integral theorem – Cauchy's integral formula – Generalized integral formula.

UNIT - IV

Power series expansions of complex functions and contour Integration:

Radius of convergence – Expansion in Taylor's series, Maclaurin's series and Laurent series. Singular point – Isolated singular point – pole of order m – essential singularity. Residue – Evaluation of residue by formula and by Laurent series – Residue theorem. Evaluation of integrals

UNIT - V

Conformal Mapping:

Transformation of z-plane to w-plane by a function, conformal transformation. Standard transformations-Translation; Magnification and rotation; inversion and reflection, Transformations like e^z , logz, z^2, and Bilinear transformation. Properties of Bilinear transformation, determination of bilinear transformation when mappings of 3 points are given.

TEXT BOOKS:

1. Advanced Engineering Mathematics by Kreyszig, John Wiley & Sons.
2. Higher Engineering Mathematics by Dr. B.S. Grewal, Khanna Publishers.

REFERENCES:

1. Complex Variables Principles And Problem Sessions By A K. Kapoor, World Scientific Publishers
2. Engineering Mathematics-3 By T. K. V. Iyengar and B. Krishna Gandhi Etc
3. A Text Book Of Engineering Mathematics By N P Bali, Manesh Goyal
4. Mathematics for Engineers and Scientists, Alan Jeffrey, 6th Edit. 2013, Chapman & Hall/CRC
5. Advanced Engineering Mathematics, Michael Greenberg, Second Edition. Person Education
6. Mathematics For Engineers By K. B. Datta AND M.A S. Srinivas, Cengage Publications

X. COURSE PLAN:

At the end of the course, the students are able to achieve the following course learning outcomes.

Lecture Notes	Course Learning Outcomes	Topics to be covered	Reference
1-2	Solve Cauchy's and Legendre's	Linear ODE with variable coefficients and	T1,R2

	differential equations	series solution(second order only) Equations reducible to constant coefficient Cauchy's and Legendre's differential equations	
3-4	Identify ordinary points, singular points and regular singular points for the given ODE	Motivation for series solution Ordinary and regular point of a differential equation	T1,R2
5-8	Determine the solution of ordinary differential equations in series form	Transformation of non-zero singular point to zero singular point Series solutions of differential equations around zero	T1,R2
9-10	Apply the Frobenius method to obtain a series solution for the given linear ODE	Frobenius Method about zero	T1,R2
11-14	Identify Legendre equation	Special Functions General solution of Legendre's differential equation ,Legendre polynomials properties, Rodrigue's formula	T1,R2
15-16	Explain Recurrence relations	Recurrence relations	T1,R2
17-18	Define generating function	generating function of Legendre's polynomials – Orthogonality	T1,R2
19-26	Demonstrate Bessel's Differential equation	Bessel's Differential equation, Bessel functions properties: – Recurrence relations, Orthogonality, Generating function	T1,R2
27	Explaining trigonometric expansions	Trigonometric expansions involving Bessel functions.	T1,R2
28-32	Define complex function	Complex Functions –Differentiation and Integration: Complex functions and its representation on Argand plane, Concepts of limit Continuity, Differentiability, Analyticity, Cauchy-Riemann conditions	T1,R2
33-38	Evaluate line integrals	Harmonic functions– Milne – Thompson method. Line integral – Evaluation along a path and by indefinite integration	T1,R2
39-42	Apply Cauchy's integral theorem	Cauchy's integral theorem – Cauchy's integral formula – Generalized integral formula	T1,R2
43-46	Define power series expansions	Power series expansions of complex functions and contour Integration: Radius of convergence – Expansion in Taylor's series, Maclaurin's series and Laurent series.	T1,R2
47-54	Evaluate integrals	Singular point –Isolated singular point – pole of order m – essential singularity. Residue – Evaluation of residue by formula and by Laurent series – Residue theorem. Evaluation of integrals	T1,R2
55-61	Describe standard transformation	Conformal mapping: Transformation of z-plane to w-plane by a function, conformal transformation. Standard transformations- Translation; Magnification and rotation; inversion and reflection,	T1,R2
62-65	Determine bilinear transformation	Transformations like e^z, logz, z^2, and Bilinear transformation. Properties of Bilinear transformation, determination of bilinear transformation when mappings of 3 points are given.	T1,R2

XI. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PSO1	PSO2	PSO3	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I	H	H	S										S	S	
II	S	H	S										S	S	
III	H	S	H										S	S	

S - Supportive H - Highly Related

XII. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	H	H	S										S	S	
2	H	S											S	S	
3	S	S		S									S	S	
4	H												S	S	
5	S		H										S	S	
6	H												S	S	
7		H											S	S	
8	H												S	S	
9		S											S	S	
10		S	S										S	S	
11	S												S	S	
12	H			S									S	S	

S - Supportive **H - Highly Related**

Prepared By: Mr. G. Nagendra Kumar, Assistant Professor

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