INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTION FORM

Course Title	**MATHEMATICS -III**			
Course Code	**R15-** A30007			
Course Structure	**Lectures**	**Tutorials**	**Practicals**	**Credits**
	4	1	-	4
Course Coordinator	Ms Subba Laxmi			
Team of Instructors	Ms. C Rachana, Mr. Ch Soma Shekhar			

I. COURSE OVERVIEW:

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 / Week	Prerequisites
UG	4	5	Basic Calculus

III. MARKS DISTRIBUTION:

Sessional Marks	University End Exam Marks	Total Marks
There shall be 2 midterm examinations. Each midterm examination consists of one objective paper, one subjective paper and one assignment. The objective paper is for 10 marks and subjective paper is for 10 marks, with duration of 1 hour 20 minutes (20 minutes for objective and 60 minutes for subjective paper). Objective paper is set for 20 bits of – multiple choice questions, fill-in the blanks, 10 marks. Subjective paper consists of 4 full questions of which, the student has to answer 2 questions, each question carrying 5 marks. First midterm examination shall be conducted for 1^{st} ,2^{nd} and 3^{rd}unit(half) of syllabus, second midterm examination shall be conducted for 3^{rd} (half),4^{th} and	75	100

5th units. 5 marks are allocated for assignments (as specified by the concerned subject teacher) – first assignment should be submitted before the conduct of the first mid, second assignment should be submitted before the conduct of the second mid. The total marks secured by the student in each midterm examination are evaluated for 25 marks, and the average of the two midterm examination marks shall be taken as the final sessional marks secured by each candidate		

IV. EVALUATION SCHEME:

S. No	Component	Duration (hours)	Marks
1	I Mid Examination	1 hour and 20 min	20
2	I Assignment lot		5
		TOTAL	**25**
3	II Mid Examination	1 hour and 20 min	20
4	II Assignment lot		5
		TOTAL	**25**
5	MID Examination marks to be considered as average of above 2 MID's TOTAL		
6	EXTERNAL Examination	3	75
7		**GRAND TOTAL**	**100**

V. COURSE OBJECTIVES:

1. The objective is to expose the students to series solutions, special functions,complex functions and conformal mapping.
2. To provide an introduction to special functions and its properties.
3. Develop an understanding the role of complex functions in Engineering.

VI. COURSE OUTCOMES:

By the end of the module students should be able to

a. **Solve** Cauchy's and Legendre's differential equations.
b. **Identify** ordinary points, singular points and regular singular points for the given ODE.
c. **Determine** the solution of ordinary differential equations in series form, Frobenius method to obtain a series solution for the given linear ODE.
d. **Identify** Bessel equation and Legendre equation and solve them under special conditions with the help of series solutions method.
e. **Analyze** the complex functions with reference to their analyticity, Integration using Cauchy's integral theorem.
f. **Identify** the conditions for a complex variable function to be analytic and/or harmonic.
g. **Define** singularities of a function; know the different types of singularities.
h. **Determine** the points of singularities of a function.
i. **Solve** integrals using residues.
j. **Apply** techniques of Complex analysis to summation of series.
k. **Solve** the Taylor's and Laurent series expansion of complex functions.
l. **Explain** the concept of transformation in a complex space and sketch associated diagrams.

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, Tutorials
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.	H	Assignments
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.	S	Assignments
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	S	Assignments
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.	N	--
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assesssocietal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	N	--
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutionsin societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	N	--
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms ofthe engineering practice.	N	--
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.	N	--
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.	N	--
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.	N	--
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological	N	--

Program Outcomes		Level	Proficiency assessed by
	change.		

N - None S - Supportive H - Highly Related

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		LEVEL	PROFICIENCY ASSESSED BY
PSO 1	**Professional Skills:** An ability to understand the basic concepts in Electronics & Communication Engineering and to apply them to various areas like Electronics, Communications, Signal processing, VLSI, Embedded systems etc.,in the design and implementation of complex systems.	H	Lectures and Assignments
PSO 2	**Problem-solving skills:** An ability to solve complex Electronics and communication Engineering problems, using latest hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions.	S	Tutorials
PSO 3	**Successful career and Entrepreneurship:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	S	Seminars and Projects

N - None S - Supportive H – Highly Related

IX. SYLLABUS:

UNIT – I:

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

Equations reducible toconstant 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, Legendrepolynomials 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 Argandplane, 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.IyengarandB.Krishna Gandhi Etc
3. A Text Book Of Engineering Mathematics By N P Bali, ManeshGoyal
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 No	Course Learning Outcomes	Topics to be covered	Reference
1-2	**Solve** Cauchy's and Legendre's differential equations	**Linear ODE with variable coefficients and series solution(second order only)** Equations reducible to constant coefficient Cauchy's and Legendre's differential equations	T1,R2
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 Argandplane, 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. Standardtransformations- 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										H	S	
II	S	H	S										H	S	
III	H	S	H										H	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
a	H	H	S										H	S	
b	H	S											H	S	
c	S	S		S									H	S	
d	H												H	S	
e	S		H										H	S	
f	H												H	S	
g		H											H	S	
h	H												H	S	
i		S											H	S	
j		S	S										H	S	
k	S												H	S	
l	H			S									H	S	

S - Supportive H - Highly Related

Prepared by: Ms. Subba Laxmi, Ms. C Rachana, Mr. Ch Soma Shekhar.

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