INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**COMPLEX ANALYSIS AND PROBABILITY DISTRIBUTION**				
Course Code	AHS004				
Programme	B. Tech				
Semester	II	ECE			
	IV	AE | EEE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Ms. C Rachana, Assistant Professor				
Course Faculty	Mr. Ch Soma shekhar, Assistant Professor Mr. J Suresh Goud, Assistant Professor Ms. P Rajani, Assistant Professor				

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 single random variables. The mathematical skills derived from this course form a necessary base to analytical and design concepts encountered in the program.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Complex Analysis And Probability Distribution	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Presentation on real-world problems
PO 2	**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	3	Seminar
PO 4	**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.	2	Term Paper

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Problem Solving**: Exploit the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	1	Seminar
PSO 2	**Professional Skills:** Identify 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.	-	-
PSO 3	**Modern Tools in Electrical Engineering:** Comprehend the technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test, maintain power systems and industrial applications.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Understand the basic theory of complex functions to express the power series.
II	Evaluate the contour integration using Cauchy residue theorem.
III	Enrich the knowledge of probability on single random variables and probability distributions.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS004.01	CLO 1	Define continuity, differentiability, analyticity of a function using limits.	PO 1	3
AHS004.02	CLO 2	Understand the conditions for a complex variable to be analytic and/or entire function.	PO 1	3
AHS004.03	CLO 3	Understand the concepts of Cauchy-Riemann relations and harmonic functions.	PO 2	3
AHS004.04	CLO 4	Understand the concept of complex	PO 4	1

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
		differentiation to the real-world problems of signals modulated by electromagnetic waves.		
AHS004.05	CLO 5	Evaluate the area under a curve using the concepts of indefinite integration	PO 2	2
AHS004.06	CLO 6	Understand the concepts of the Cauchy's integral formula and the generalized Cauchy's integral formula.	PO 2	2
AHS004.07	CLO 7	Evaluate complex functions as power series and radius of convergence of power series.	PO 1	3
AHS004.08	CLO 8	Understand the concept of complex integration to the real-world problems of flow with circulation around a cylinder.	PO 4	1
AHS004.09	CLO 9	Solve the Taylor's and Laurent series expansion of complex functions	PO 2	3
AHS004.10	CLO 10	Understand the concept of different types of singularities for analytic function.	PO 1	3
AHS004.11	CLO 11	Evaluate poles, residues and solve integrals using Cauchy's residue theorem.	PO 1	3
AHS004.12	CLO 12	Evaluate bilinear transformation by cross ratio property.	PO 1	2
AHS004.13	CLO 13	Identify the conditions of fixed and critical point of Bilinear Transformation.	PO 4	2
AHS004.14	CLO 14	Understand the concept of Cauchy's residue theorem to the real-world problems of Quantum Mechanical scattering and Quantum theory of atomic collisions.	PO 4	2
AHS004.15	CLO 15	Demonstrate an understanding of the basic concepts of probability and random variables.	PO 4	2
AHS004.16	CLO 16	Classify the types of random variables and calculate mean, variance.	PO 2	3
AHS004.17	CLO 17	Finding moment about origin, central moments, moment generating function of probability distribution.	PO 2	3
AHS004.18	CLO 18	Understand the concept of random variables to the real-world problems like graph theory, machine learning and natural language processing	PO 4	3
AHS004.19	CLO 19	Recognize where the binomial distribution and poisson distribution could be appropriate model and find mean, variance of the distributions.	PO 1, PO 2	3
AHS004.20	CLO 20	Apply the inferential methods relating to the means of normal distributions.	PO 1, PO 2	3
AHS004.21	CLO 21	Understand binomial distribution to the phenomena of real-world problem like sick versus healthy.	PO 4	3
AHS004.22	CLO 22	Understand the mapping of normal distribution in real-world problem to analyze the stock market.	PO 1	3
AHS004.23	CLO 23	Use poission distribution in real-world problem to predict soccer scores.	PO 4	3
AHS010.24	CLO 24	Possess the knowledge and skills for employability and to succeed in national and international level competitive examinations.	PO 4	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												1		
CLO 2	3												1		
CLO 3		3											1		
CLO 4				1											
CLO 5		2											1		
CLO 6		2											1		
CLO 7	3														
CLO 8				1											
CLO 9		3											1		
CLO 10	3												1		
CLO 11	3														
CLO 12	2														
CLO 13				2											
CLO 14				2									1		
CLO 15				2											
CLO 16		3													
CLO 17		3											1		
CLO 18				3									1		
CLO 19	3	2											1		
CLO 20	3	2											1		
CLO 21				3											
CLO 22	3												1		
CLO 23				3											
CLO 24				2											

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1,PO 2,PO4	SEE Exams	PO1,PO 2,PO4	Assignments	PO 2	Seminars	PO 2
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO 4						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

Unit-I	**COMPLEX FUNCTIONS AND DIFFERENTIATION**
Complex functions differentiation and integration: Complex functions and its representation on argand plane, concepts of limit, continuity, differentiability, analyticity, Cauchy-Riemann conditions and harmonic functions; Milne-Thomson method.	
Unit-II	**COMPLEX INTEGRATION**
Line integral: Evaluation along a path and by indefinite integration; Cauchy's integral theorem; Cauchy's integral formula; Generalized integral formula; Power series expansions of complex functions and contour Integration: Radius of convergence.	
Unit-III	**POWER SERIES EXPANSION OF COMPLEX FUNCTION**
Expansion in Taylor's series, Maclaurin's series and Laurent series. Singular point; Isolated singular point; Pole of order m; Essential singularity; Residue: Cauchy Residue Theorem. Evaluation of Residue by Laurent Series and Residue Theorem. Evaluation of integrals of the type $\int_0^{2\pi} f(\cos\theta,\sin\theta)d\theta$ and $\int_{-\infty}^{\infty} f(x)dx$ Bilinear Transformation	
Unit-IV	**SINGLE RANDOM VARIABLES**
Random variables: Discrete and continuous, probability distributions, mass function-density function of a probability distribution. Mathematical expectation. Moment about origin, central moments, moment generating function of probability distribution.	
Unit-V	**PROBABILITY DISTRIBUTIONS**
Binomial, Poisson and normal distributions and their properties.	
Text Books:	
1.Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Publishers, 10th Edition, 2010 2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, 2015.	
Reference Books:	
1.T.K.V Iyengar, B.Krishna Gandhi, "Engineering Mathematics - III", S. Chand & Co., 12th Edition, 2015. 2.T.K.V Iyengar, B.Krishna Gandhi, "Probability and Statistics", S. Chand & Co., 7th Edition, 2015. 3.Churchill, R.V. and Brown, J.W, "Complex Variables and Applications", Tata Mc Graw-Hill, 8th Edition, 2012.	

XIV. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Understanding the complex function in Argand plane	CLO 1	T1:12.1 R1:4.2
2	Apply the limit of a complex function	CLO 1	T1:12.3 R1:4.4
3	Apply the continuity of a complex function	CLO 1	T1:12.3 R1:4.6
4	Apply the differentiability and analyticity of a complex function	CLO 1	T1:12.3 R1:4.7
5-6	Identify and Apply the of Cauchy-Riemann conditions in Cartesian and Polar forms	CLO 3	T1:12.4 R1:4.13
7	Evaluate the Harmonic Conjugates	CLO 3	T1:12.4 R1:4.15
8-9	Apply the Milne-Thomson method to find the Analytic function	CLO 3	T1:12.4 R1:4.20
10-11	Demonstrate the Line Integral for a given path	CLO 5	T1:13.1 R1:5.3
12	Analyze the Cauchy's integral theorem in a given plane	CLO 5	T1:13.2 R1:5.5
13-14	Explain the Cauchy's integral formula	CLO 6	T1:13.3 R1:5.9
15-16	Analyze the Cauchy's general integral formula	CLO 6	T1:13.4 R1:5.10
17	Define the Power series expansions of complex functions and contour Integration	CLO 7	T1:14.1 R1:6.1
18	Evaluate the Radius of convergence of power series complex function	CLO 7	T1:14.2 R1:6.1
19-20	Identify the types of power series expansions	CLO 7	T1:14.4 R1:6.2
21	Define the types of Singularities and its nature	CLO 10	T1:15.2 R1:6.6
22	Define the concept of Residues	CLO 11	T1:15.1 R1:7.4
23-24	Evaluate the Residue	CLO 11	T1:15.1 R1:6.5
25	Evaluate of contour integrals	CLO 11	T1:15.3 R1:7.9
26	Analyze the properties of Bilinear transformation	CLO 12	T1:12.5 R1:8.8
27	Understand the basic concepts of Random variables	CLO 15	T2:26.7 R2:2.2
28-29	Understand the types of Probability distributions	CLO 16	T2:26.8 R2:2.6
30-31	Evaluate the Mass function, Density function	CLO 15	T2:26.8 R2:2.7
32	Define the Expectations of Probability Distribution	CLO 16	T2:26.10 R2:2.6
33-34	Evaluate the Moment and Central moments	CLO 17	T2:25.9

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
			R2:3.2
35-36	Evaluate the Moment Generating functions	CLO 17	T2:26.11 R2:3.5
37-39	Understand and Apply the Binomial Distribution parameters	CLO 21	T2:26.14 R2:4.4
40-42	Understand and Apply the Poisson Distribution parameters	CLO 23	T2:26.15 R2:4.10
43-45	Understand and Apply the Normal Distribution parameters	CLO 20	T2:26.16 R2:4.15

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed Actions	Relevance With Pos	Relevance With Psos
1	Problem reductions, Conformal mapping	Seminars	PO 1	PSO 1
2	In order to monitor the quality of products to plan effective and efficient designs to improve standards to test and analyze the quality of items	Seminars / NPTEL	PO 4	PSO 1
3	Encourage students based on the taught statements to solve problems	NPTEL	PO 2	PSO 1

Prepared by:
Ms. C Rachana, Assistant Professor

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