Course Specification
(Bachelor)

Course Title:	**Complex Variable**
Course Code:	**MAT 1412**
Program:	**Bachelor of Science in Applied Mathematics**
Department:	**Mathematics and Statistics**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	**2024 – V1**
Last Revision Date:	**08/10/2024**

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A. General information about the course:

1. Course Identification

1. Credit hours:					
4 (3 Lectures, 0 Lab, 2 Tutorial)					
2. Course type					
A.	☐University	☐ College	☒ Program	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: Level 7 / Year 4					
4. Course general Description:					
This course introduces students to the fundamentals of complex analysis, covering topics such as complex numbers, limits, continuity, and differentiability of complex functions. Key concepts include the Cauchy-Riemann equations, analytic functions, complex integration, and essential theorems like Cauchy's theorem and the residue theorem. Students will also explore power series, convergence, and applications of conformal mapping,					
5. Pre-requirements for this course (if any):					
MAT 1311 Real Analysis.					
6. Co-requisites for this course (if any):					
None.					
7. Course Main Objective(s):					
The main objective of this course is to equip students with a thorough understanding of complex analysis, enabling them to analyze and solve problems involving complex functions while applying theoretical concepts to practical scenarios in mathematics and engineering.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	75	100%
2	E-learning	0	0%
3	Hybrid • Traditional classroom • E-learning	0	0%
4	Distance learning	0	0%

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	0
3.	**Field**	0

4.	**Tutorial**	30
5.	**Others (specify)**	0
Total		75

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	To recognize complex functions and their properties: continuity, differentiation, Cauchy-Riemann equations, and analyticity.	K1, K2	4 lecture hours\week	Regular Exams
1.2	To outline line integrals, complex contour integrals, series, and residues.	K1, K2	2 tutorial hours\week Self-study	Assignments Short Quizzes
2.0	**Skills**			
2.1	To develop techniques of integration by using residues.	S1, S2	Real-life problems	Short Quizzes
2.2	To present Complex integral and its applications clearly and precisely both orally and in writing.	S4	Self-study	Participations
2.3	To use Internet in searching for complex sequences and series	S5	Real-life problems	Short Quizzes
2.4	To demonstrate some proofs of ODE solutions by using complex series.	S3	Self-study	Participations
3.0	**Values, autonomy, and responsibility**			
3.1	To work individually.	V1, V3	Personal questions	Participation
3.2	Develop personal values and attributes such as honesty, empathy and respect for others.	V1, V2	Team work	Homework and Mini-projects

C. Course Content

No	List of Topics	Contact Hours
1.	**Basics:** Euler formula and exponential form of a complex number, Basic topological properties, Functions of complex variable, Elementary functions, Limits, continuity and uniform continuity.	**10**
2.	**Continuity and differentiability:** Limits, Continuity and uniform continuity, Derivative of a complex function at a point, Cauchy-Riemann equations and differentiability of complex functions, Derivatives of elementary functions, Analytic function at a point, Singular points, Analytic function and harmonic functions, Hopital's rule.	**20**
3.	**Complex integral:** Line integral and complex integral, Complex form of Green's theorem, Cauchy's and Cauchy-Goursat theorems, Complex indefinite integral, Cauchy's integral formula, Argument, Rouche's, Liouville's, and modulus theorems.	**20**
4.	**Complex sequences and series:** Basic definitions, tests of series absolute convergence, power series and uniform convergence, circle of convergence, differentiation and integration of power series, Taylor's series and Laurent's series. Type of singular points, Picard's theorem.	**15**
5.	**Residues:** Residues and the residue theorem with applications.	**5**
6.	**Basic concepts of conformal mapping.**	**5**
Total		**75**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	HomeWorks, Quizzes, Mini-projects	During the term	10%
2.	First Midterm	Week 5-6	25%
3.	Second Midterm	Week 10-11	25%
4.	Final Exam	Week 15	40%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	*Complex Variables: Introduction and Applications*, **M. Ablowitz et al, 2nd Edition, 2003. (Main Reference)**

Supportive References	*Complex Variables and applications*, **R.V. Churchill and J.W. Brown, McGraw-Hill 5th Edition, 1989.**
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• **Classrooms:** Equipped with whiteboards, projectors, and Smart Boards for interactive lessons and group discussions. • **Laboratories:** Feature computers with internet access, enabling hands-on activities and exploration of algebraic and trigonometric concepts. • **Exhibition Rooms:** Spaces for showcasing projects and presentations to encourage collaborative learning.
Technology equipment (projector, smart board, software)	• **Data Show Projectors:** For clear presentations in classrooms and labs. • **Smart Boards:** To enhance interactivity during lessons. • **Mathematical Software:** Essential for graphing and analysis.
Other equipment (depending on the nature of the specialty)	• **Computers:** For mini-project and homework and practical applications in laboratories. • **Advanced Calculators:** For computations and problem-solving and supporting the study of limits, continuity, and differentiation. • **Whiteboards and Markers:** To facilitate brainstorming and collaboration.

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Student and teaching staff	Surveys and Questionnaires
Effectiveness of Students assessment	Course Coordinator	Peer Reviews
Quality of learning resources	Students and teaching staff	Classroom Observations
The extent to which CLOs have been achieved	Student Representatives	Student Performance Evaluations (exams, projects) CLOs Excel sheet.
Other	**None**	

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL**
REFERENCE NO.	**8/1446**
DATE	**05/04/1446 (08/10/2024)**