Course Specification

(Postgraduate Programs)

Course Title:	**Complex Analysis**
Course Code:	**MAT 7113**
Program:	**Doctor of Philosophy in Mathematics**
Department:	**Mathematics and Statistics**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	**2024 – V1**
Last Revision Date:	**None**

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours:					
4 (4 Lectures, 0 Lab, 0 Tutorial)					
2. Course type					
A.	☐ University	☐ College	☒ Program	☐ Track	☐ Others
B.	☒ Required		☐ Elective		
3. Level/Year at which this course is offered: Level 1/ Year 1					
4. Course general Description:					
This Graduate Complex Analysis course describes the most important topics of analytic functions, complex integration, Cauchy's Theorem, the Maximum Modulus Principle, Liouville's Theorem, Harmonic Functions, Taylor and Laurent Series, singularities, the Residue Theorem, … It also covers conformal mapping, normal families, the Riemann Mapping Theorem, and harmonic functions.					
5. Pre-requirements for this course (if any)**:**					
None.					
6. Co-requisites for this course (if any)**:**					
None.					
7. Course Main Objective(s):					
The main objective of this course is to study the theory of functions of one complex variable through investigation of the major theorems in complex analysis: the Cauchy-Riemann Equations, Cauchy's Theorem, Cauchy's Integral Formula, the Maximum Modulus Principle, Liouville's Theorem, and the Residue Theorem, Rouche's Theorem. The theory is applied to a wide range of problems including evaluation of complex line integrals and real integrals. The concept of Conformal Mapping and the Riemann Mapping Theorem will be studied as well as Harmonic Functions.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	60	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**	60
2.	**Laboratory/Studio**	0
3.	**Field**	0

4.	**Tutorial**	**0**
5.	**Others (specify)**	**0**
Total		**72**

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 record methods and major theorems in complex analysis.**	**K1, K2**	**4 lecture hours\week**	**Direct: Regular Exams**
1.2	**To recognize concepts of conformal mapping, normal families, Riemann Mapping Theorem, and harmonic functions.**	**K1, K2**	• **4 lecture hours\week** • **Self-study**	**Direct: Regular Exams**
2.0	**Skills**			
2.1	**To create techniques of proof in Laurent series.**	**S1, S2**	**Self-study**	**Direct:** • **Participation** • **Homework**
2.2	**To develop oral communication and technical writing skills through harmonic functions.**	**S3**	**Self-study**	**Direct: Homework and Mini projects**
2.3	**To use Internet in searching for conformal mappings**	**S4**	**Self-study**	**Direct:** • **Participation** • **Homework**
2.4	**To carry out deep and proofs in integral formulas.**	**S1, S2**	**Self-study**	**Direct:** • **Participation** • **Homework**
3.0	**Values, autonomy, and responsibility**			
3.1	**To work with independence and responsibility**	**V1, V3**	**Personal questions**	**Direct: Participation**
3.2	**To collaborate positively with work groups**	**V1, V2**	**Teamwork and class discussions.**	**Direct: Homework and Mini projects**

C. Course Content

No	List of Topics	Contact Hours
1.	**Review of Basics:** Cauchy-Riemann Theorem and Applications, Analytic and Entire Functions, Liouville's Theorem.	**10**

2.	**Laurent Series and the Residue Theorem:** Power Series and Taylor Series, Laurent's Series and Isolated Singular Points, Rouche's Theorem and the Inverse of Analytic Function, Residue Theorem and Applications, The Identity Theorem, Maximum Modulus Theorem.	**18**
3.	**Conformal Mapping and the Riemann Mapping Theorem:** Conformal Mapping, Normal Families, Mobius Transformations, Riemann's Mapping Theorem of infinite Product, Runge's and Mittag-Leffler Theorems.	**18**
4.	**Harmonic Functions:** Harmonic Functions, Laplace's Equation, The Maximal Principal Poisson Integral Formula, Schwarz Reflection Principle, Dirichlet's Problem on Disk.	**14**
Total		**60**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**HomeWorks, Quizzes, Mini projects**	**During the semester**	**30%**
2.	**Midterm**	**Week 9-10**	**30%**
3.	**Final Exam**	**Week 15-16**	**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	**J. Conway;** Functions of One Complex Variable, GTM, Springer-Verlag 1978. **(Main Reference)**
Supportive References	1. **W. Rudin**; Real and Complex Analysis, McGraw-Hill 1987. 2. **L. Ahlfors;** Complex Analysis, McGraw-Hill 1966.
Electronic Materials	**None**
Other Learning Materials	**None**

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	▪ **Each classroom should be equipped with a whiteboard and a projector.** ▪ **Laboratories should be equipped with computers and an internet connection.**

Items	Resources
Technology equipment (projector, smart board, software)	**The rooms should be equipped with data show and Smart Board.**
Other equipment (depending on the nature of the specialty)	**None**

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	**Students**	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of Students assessment	**Program Leaders**	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Quality of learning resources	**Students**	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory-GCC)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio.
	Course Responsible	**Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
The extent to which CLOs have been achieved	**Course Responsible**	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
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)**