MA3517: COMPLEX ANALYSIS

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Complex Analysis

Subject Code
MA - Mathematics
Course Number
3517

Academic Unit
Mathematics (MA)

College/School
College of Science (SI)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
MA2508 Multi-variable Calculus

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course aims to provide an introduction on the theory and applications of functions of a complex variable. It will help students to understand the basic theory of complex analysis and apply the methods to solve problems in physics and engineering.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	explain at high level concepts from complex analysis, including analyticity of functions and conformality of mappings.	10	x		
2	state and prove rigorously mathematical statements concerning analytic functions.	15	x		
3	generate power series and Laurent series expansions of complex-valued functions.	15		x	
4	evaluate line/contour integrals directly or by using the residue theorem, and compute real integrals via contour integration.	20		x	
5	determine images of curves and sets under complex mappings, particularly conformal maps.	10		x	
6	apply techniques of complex analysis in other mathematical and scientific applications, such as Laplace and Fourier transforms.	20	x	x	x
7	the combination of CILOs 1-6	10	x	x	x

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	Learning through teaching is primarily based on lectures.	1, 2, 3, 4, 5, 6, 7	39 hours in total

2	Take-home assignments	Learning through take-home assignments helps students understand basic concepts of complex analysis and practise techniques of series expansion and contour/ real integral computation.	1, 2, 3, 4, 5, 6	after-class
3	Online applications	Learning through online examples for applications helps students create and formulate mathematical models in science/ engineering with techniques of complex analysis.	6	after-class
4	Math Help Centre	Learning activities in Math Help Centre provides students extra help.	1, 2, 3, 4, 5, 6	after-class

Assessment Tasks / Activities (ATs)

	ATs	**CILO No.**	**Weighting (%)**	**Remarks (e.g. Parameter for GenAI use)**
1	Test	1, 2, 3	21	Questions are designed for the first part of the course to see how well students have learned the concept of analyticity of complex-valued functions and its function-theoretic consequences.
2	Hand-in assignments	1, 2, 3, 4, 5, 6	9	These are skills based assessment to enable students to apply basic concepts and techniques of complex analysis in proving mathematical statements, evaluating real/contour integrals, performing integral transforms and modeling a range of scientific applications.
3	Formative take-home assignments	1, 2, 3, 4, 5, 6	0	The assignments provide students chances to demonstrate their achievements on methods of complex analysis learned in this course.

Continuous Assessment (%)

30

Examination (%)
70

Examination Duration (Hours)
2

Additional Information for ATs
30% Coursework
70% Examination (Duration: 2 hours, at the end of the semester)

For a student to pass the course, at least 30% of the maximum mark for the examination must be obtained.

Assessment Rubrics (AR)

Assessment Task
1. Test

Criterion
ABILITY to APPLY and EXPLAIN the methodology of limits, derivatives, integrals of functions of one complex variable.

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
2. Hand-in assignments

Criterion
CAPACITY for SELF-DIRECTEDLEARNING to understand the properties of complex functions, in particular, the analytic functions.

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
3. Formative take-home assignments

Criterion
CAPACITY for SELF-DIRECTEDLEARNING to apply principles of complex analysis to some problems in science and engineering

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
4. Examination

Criterion
ABILITY to DEVELOP mathematical models through complex analysis and SOLVE problems with different methods

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

Functions of a complex variable. Cauchy-Riemann equations. Conformal mapping. Analytic functions. Contour integrals. Cauchy integral theorem. The residue theorem. Laplace and Fourier transforms.

Reading List

Compulsory Readings

	Title
1	Complex variables and applications, by Ruel V. Churchill, James Ward Brown.

Additional Readings

	Title
1	Fundamentals of complex analysis with applications to engineering and science, by E.B. Saff, A.D. Snider.
2	Complex analysis: an introduction to the theory of analytic functions of one complex variable, by Lars V. Ahlfors.
3	A collection of problems on complex analysis, by L.I. Volkovyskii, G.L. Lunts, I.G. Aramanovich.