COURSE OUTLINE: MH3101

Course Title	**Complex Analysis**	
Course Code	**MH3101**	
Offered	Study Year 3, Semester 1	
Course Coordinator	Juan-Pablo Ortega (Prof)	juan-pablo.ortega@ntu.edu.sg
Pre-requisites	MH1101 and MH2100	
Mutually exclusive	MH2801	
AU	4	
Contact hours	Lectures: 39, Tutorials: 12	
Approved for delivery from	AY 2022/23 semester 1	
Last revised	8 Aug 2022, 09:27	

Course Aims

This is the only courses on complex analysis and is compulsory for students of mathematical sciences tracked in pure and applied mathematics. The course aims to present an introduction to the theory of functions of a complex variable that is useful in many branches of pure and applied mathematics and computer engineering as well. This course carefully treats the principal topics, such as limits, continuity, differentiability of complex-valued functions of a complex variable, complex integral, Taylor series, singularity, Laurent series, calculus of residues, analytic functions as geometric mappings, and to illustrate the power of the subject through a variety of applications. After learning this course, you will be able to make connections between the complex-valued functions and real-valued functions of two real variables studied in Calculus III, as well as advantages of complex-valued functions in solving several problems in real analysis.

Intended Learning Outcomes

Upon successfully completing this course, you should be able to:

1. Explain the setting of the concepts of complex-valued functions of a complex variable
2. Translate between problems in complex analysis and problems in real analysis using different approaches, as well as what have already been studied in MH1100, MH1101, MH2100
3. Prove the mathematical statements in Complex Analysis.
4. Apply methods of Complex Analysis to solve problems in real analysis, computer science and engineering involving complex numbers

Course Content

Analytic functions of one complex variable; Complex derivative; Elementary functions; Cauchy-Riemann equations

Contour integrals; Cauchy's theorem and Cauchy's integral formula; Liouville's theorem, Fundamental Theorem of Algebra

Taylor series, Laurent series, Singularities of analytic functions

Residue theorem, Calculus of residues, Applications

Analytic functions as geometric mappings, Maximum modulus principle, Schwarz lemma, Conformal mappings

Assessment

Component	Course ILOs tested	SPMS-MAS Graduate Attributes tested	Weighting	Team / Individual	Assessment Rubrics
Continuous Assessment					
Tutorials					
Assignment	1, 2, 3	**1.** a, b, c **2.** a, b, c **3.** a	25	individual	See Appendix for rubric
Mid-semester Quiz					
Short Answer Questions	1, 2, 3	**1.** a, b, c **2.** a, b, c **3.** a	25	individual	See Appendix for rubric
Examination (2 hours)					
Short Answer Questions	1, 2, 3, 4	**1.** a, b, c **2.** a, b, c **3.** a	50	individual	See Appendix for rubric
		Total	**100%**		

These are the relevant SPMS-MAS Graduate Attributes.

1. **Competence**
   a. Independently process and interpret mathematical theories and methodologies, and apply them to solve problems
   b. Formulate mathematical statements precisely using rigorous mathematical language
   c. Discover patterns by abstraction from examples
2. **Creativity**
   a. Critically assess the applicability of mathematical tools in the workplace
   b. Build on the connection between subfields of mathematics to tackle new problems
   c. Develop new applications of existing techniques
3. **Communication**
   a. Present mathematics ideas logically and coherently at the appropriate level for the intended audience

Formative Feedback

Feedback will be given to students through the weekly problem tutorial sets that are covered in tutorial. Common mistakes in the assignment and the midterm test will be discussed in the provided solution sets.

Learning and Teaching Approach

Lectures (39 hours)	Examples and Explanation - Motivates the concepts in the learning objectives through examples. The general theory and principles are then explained. Problem solving - Develops competence in solving a variety of problems and gaining familiarity with mathematical proofs.
Tutorials (12 hours)	Examples and Explanation - Motivates the concepts in the learning objectives through examples. The general theory and principles are then explained. Problem solving - Develops competence in solving a variety of problems and gaining familiarity with mathematical proofs. Peer Instruction - You will work together to gain experience in explaining concepts to others and presenting solutions.

Reading and References

* Textbook
J.W. Brown & R.V. Churchill, Complex Variables and Applications, McGraw-Hill, Ninth Edition, 2014
ISBN-13: 978-0073383170, ISBN-10: 0073383171

* Reference-book
E.B. Saff, A.D. Snider, Fundamentals of Complex Analysis: Engineering, Science, and Mathematics, Pearson, Third Edition, 2014
ISBN: 0-13-907874-6

Course Policies and Student Responsibilities

Advice for students:

1.This course is not easy, so get with it from the start or you'll have great difficulty later
2.The more you work in August, the less you have to worry in November
3.Ask questions and consult with your classmates
4.Do the assigned questions and go to the tutorial sessions
5.Review your notes before coming to class and make sure you understand the last lecture

Assessments:

1.A late submission for an assignment is not accepted
2.No make-up midterm test will be arranged
3.A student who is absent from a Midterm test without valid Leave of Absence will be given zero mark.
4.In case of a valid reason for absence, the total course marks would subsequently be rescaled to a base of 100%.

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. Consult your instructor if you need any clarification about the requirements of academic integrity in the course.

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Course Instructors

Instructor	Office Location	Phone	Email
Juan-Pablo Ortega (Prof)			juan-pablo.ortega@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	Course ILO	Readings/ Activities
1	Complex numbers; topology of the complex plane	1, 2, 3, 4	Annotated lecture slides
2	The complex derivative; Cauchy-Riemann equations	1, 2, 3, 4	Annotated lecture slides
3	Elementary functions; multi-valued functions	1, 2, 3, 4	Annotated lecture slides
4	Complex integral	1, 2, 3, 4	Annotated lecture slides
5	Complex integral	1, 2, 3, 4	Annotated lecture slides
6	Complex integral	1, 2, 3, 4	Annotated lecture slides
7	Power series	1, 2, 3, 4	Annotated lecture slides
8	Singularities and Laurent series. Midterm exam	1, 2, 3, 4	Annotated lecture slides
9	Singularities and Laurent series	1, 2, 3, 4	Annotated lecture slides
10	Calculus of residues	1, 2, 3, 4	Annotated lecture slides
11	Analytic functions as geometric mappings	1, 2, 3, 4	Annotated lecture slides
12	Analytic functions as geometric mappings	1, 2, 3, 4	Annotated lecture slides
13	Revision	1, 2, 3, 4	Annotated lecture slides

Appendix 1: Assessment Rubrics

Rubric for Tutorials: Assignment (25%)
Point-based marking (not rubrics based)

Rubric for Mid-semester Quiz: Short Answer Questions (25%)
Point-based marking (not rubrics based)

Rubric for Examination: Short Answer Questions (50%)
Point-based marking (not rubrics based)