Complex Variables
MATH420
Course information

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Students on UI Moscow campus in fall and spring: You are encouraged to make appointments with me or use my office hours (posted on my office door) to get help with the material. I'll be happy to clarify any ambiguity in the lectures and to give pointers if you are stuck on a particular problem, however, I shall not work on your homework assignment with you nor will I check your solutions for errors in my office.

All students: When a meeting is not possible, do not hesitate to communicate any issues by email. Please follow some basic email courtesy. Emails without any address or signature can be ignored.

Recommended Text: James Ward Brown and Ruel V. Churchill, *Complex Variables and Applications*, 8th Edition

Course Webpage: www.webpages.uidaho.edu/sdatta/EOmath420.html

Course Outline: The following topics will be covered over a period of 40 lectures each of duration approximately 50 minutes.

- Complex numbers
  - Basic algebraic properties of complex numbers
  - Conjugate and modulus of a complex number
  - Polar and exponential form of a complex number
  - Roots of a complex number
- Complex differentiation and the Cauchy-Riemann equations
- Elementary functions (sin, cos, exp, log) of a complex variable
- Complex integration
  - Contour integrals
  - Cauchy's Integral Theorem
  - Cauchy's Integral Formula
  - Liouville's Theorem and The Fundamental Theorem of Algebra
- Power series representation of analytic functions

- Singularities of an analytic function
- The Residue Theorem and its application in evaluating improper real integrals
- Conformal mapping
- Applications
  - Harmonic functions
  - Dirichlet problem for a disk
  - Dirichlet problem in the upper half plane

In the book **James Ward Brown and Ruel V. Churchill, *Complex Variables and Applications*, 8th Edition** the above topics are covered in chapters 1 - 10.

Assignments, exams & grading:
Your grade in the course will be based on the following:
Homework - 20%
Midterm I (50 minutes) - 25% (after Lecture 13)
Midterm II (50 minutes) - 25% (after Lecture 28)
Final (2 hours)- 30%

All exams will be closed-book, closed-notes, and calculators will not be allowed. The final exam is comprehensive.
Part of your grade will be based on neatness and correct mathematical notation. Your work should be organized and easy for me to read or else you will lose points.

Important deadlines: The following are the deadlines by which the above exams must be taken and returned by the proctor to the EO office:

For Fall:
Midterm I: October 15
Midterm II: November 20

For Spring:
Midterm I: March 1
Midterm II: April 15

For Summer:
Midterm I: July 5
Midterm II: July 25

Unless you have taken my permission, you should strictly abide by the dates given above. You can take a test on any day before the corresponding due date. The exams must be received by the EO office **by** the above dates, otherwise, your score for the exam will be automatically set to zero. Please make a note of the above dates so that you can make arrangements with your proctor.

As soon as you finish a lecture, work on the related problems from the assignments. You should work on the assignments alongside the lectures and turn them in as you finish. In particular, you must ensure that all HWs pertaining to a certain midterm are submitted **before** that midterm. If your assignments are poorly timed, (for example, HW 1 is submitted after Midterm 2), or turned in one batch before tests or towards the end of the semester, they will **not** be considered. Besides, in such cases, I will **not** be able to provide any feedback or inform you of your HW grades.

Please scan (if handwritten) and email me your assignments in a **single** pdf. Camera shots of pages will **not** be accepted. Write your name, course name/no., and assignment no. in the subject of the email.

Learning Outcomes:

- The students will learn the basic properties of complex numbers, how to perform the basic algebraic operations of addition, subtraction, multiplication, and division with complex numbers, the different ways of representing a complex number, and how to find roots of a complex number
- The students will learn the notion of continuity and differentiability of a function of a complex variable, and the necessary and sufficient conditions of differentiability by means of the Cauchy Riemann equations.
- The students will learn to parametrize contours and compute integrals of a function of a complex variable on a contour. They will be able to use Cauchy's Integral Theorem and Cauchy's Integral formula to evaluate integrals of a function of a complex variable.
- The students will learn how to find a Taylor or Laurent series expansion of a function of a complex variable and how to determine the region of convergence of such a series.
- The students will understand the notion of singularity and how to determine and classify the singularities of a function of a complex variable.
- The students will learn how to find residues at singularities, the Residue Theorem, and how to use the Residue Theorem to evaluate certain improper integrals of real-valued functions.

- The students will learn about conformal mapping, harmonic functions, and how to solve boundary value problems like the Dirichlet problem that come up in several areas of science and engineering.

The tests will serve as an assessment tool for the learning outcomes.