Math 4220: Applied Complex Analysis
Cornell University – Fall 2021

Tu-Th 11:25AM - 12:40PM (Morrill Hall 106)

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Course Website:	https://e.math.cornell.edu/classes/math4220/
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The shortest path between two truths in the real domain passes through the complex domain. – Jacques Hadamard

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Course Description: There are not enough real numbers. For example, to solve the simple polynomial equation

$$x^2 + 1 = 0,$$

one needs to consider a system of numbers which is "larger" than the real numbers $\mathbb{R}$; these are the complex numbers $\mathbb{C}$. We shall view $\mathbb{C}$ both as a system of numbers that can be added, subtracted, multiplied and divided, and as a plane on which we can do geometry. As single-variable calculus studies functions on the real line, complex analysis focuses on the study of functions defined on the complex plane. For a special class of functions on the complex plane, called analytic functions, incredible truths hold. The main focus of this course is to study these analytic functions and their applications. In doing so, we will learn the basic calculus of analytic functions, contour integration in $\mathbb{C}$, Cauchy's integral theorem and its consequences, Laurent series, and the calculus of residues. Perhaps best of all, we will study a number of important applications, many of which seem at first to have nothing to do with complex analysis. These applications will include, at minimum, Fourier and Laplace transforms.

Prerequisites: MATH 2210-2220, 2230-2240, 1920 and 2940, or 2130 and 2310. Students will be expected to be comfortable with proofs.

Textbook: Fundamentals of Complex Analysis with Applications to Engineering and Science, E. B. Saff and A. D. Snider, 3rd Edition

You are expected to read the course textbook carefully, thoroughly and – ideally – before you come to class. As you know from previous mathematics courses, reading a mathematics textbook means to read with a pencil/pen in hand and work out all details carefully, especially those made within the course of a proof. When creating material for this course (the homework, prelims, etc.), I like to draw from many different sources. In addition to the course textbook, I will often consult *Basic Complex Analysis* by J. Marsden and M. Hoffman; *Invitation to Complex Analysis* by R. P. Boas; *Complex Variables and Applications* by J. W. Brown and R. V. Churchill; and *Fourier Analysis* by T. Körner. While you are not required to obtain these texts, you may want to take a look at them.

Grading: Your grade will be calculated as follows:

Class participation:	5%
Weekly homework assignments:	35%
Maximum of Prelims 1 & 2:	20%
Minimum of Prelims 1 & 2:	15%
Final Exam:	25%

Exams: This course will have two prelims and a final exam. The dates, times and locations for these exams are listed below.

Exam	**Date**	**Time**	**Location**
Prelim 1	**Thursday, October 14th**	**11:25AM-12:40PM**	**Morrill Hall 106**
Prelim 2	**Thursday, November 18th**	**11:25AM-12:40PM**	**Morrill Hall**
Final	**TBA**	**TBA**	**TBA**

It is important that you reserve these dates in your calendar now and plan accordingly. In the event that you are unable to attend an exam, you must let me know at least **two weeks** prior to the exam date.

Attendance and Class Participation: As participation is a big part of this course, class attendance is strongly encouraged. Of course, if you are ill or an emergency arises, it is acceptable to miss class[1]. To learn mathematics, it is essential to communicate it and to discuss it with others. I encourage you to ask questions! You will be required to participate in class discussion; in fact, it is part of your total grade.

Homework: Homework is the most important part of this course. It is where you will grapple with new ideas, come up with creative solutions and communicate your thoughts and understanding to others. Consequently, it is crucial that you take homework very seriously. You should start homework early and work diligently. If you are having substantial difficulty with a particular exercise, please come talk to me or Max during office hours. I am here to help! You are permitted and encouraged to discuss homework with your classmates, however, when it comes time to write up your solutions, you are required to do so independently and away from your peers (in another room, preferably). You are also permitted to consult other textbooks and, in this case, please give full details (beyond what's in our textbook). If you work with peers or consult material outside the textbook, you are required to cite your sources (including naming the peers with whom you worked); failure to do so is a matter of academic dishonesty and will result in grade penalties

[1] In that case, I encourage you to reach out to me beforehand so that, if possible, I can make the lecture available for remote viewing.

and/or reports of academic negligence/dishonesty. Your solutions should communicate your individual process and understanding of the material. What you turn in must be your own.

The homework for this class will be a mix of computation-type exercises and proofs/arguments. Of course, writing proofs is a difficult and monumental skill to master and we will work together to build and hone this skill. Please keep in mind the following guidelines while writing and polishing your proofs: 1) Correctness is essential. 2) The longest proof is never the best; the shortest proof is rarely good. 3) Clarity is the ideal.

For the computation-type exercises, as with your proofs, I expect your solutions to be written out correctly and presented in good mathematical prose. Your grade will depend on the correctness of your solutions and the quality of your writing. This means that your writing should follow a coherent logical structure which makes use of complete sentences and follows standard rules of grammar. Please do not submit solutions containing incoherent and unstructured calculations. You should be proud of the material you turn in!

Homework Structure and Schedule: Assignments will be posted to the course website and are to be submitted in Gradescope by their due date (which usually falls on a Tuesday). It is crucial to keep up with the homework in this course. Therefore, late homework will not be not accepted. I will drop your lowest homework score on the condition that you attend one Mathematics department colloquium or seminar and write a short (one paragraph) summary.

Homework Policies:

1. All write-ups are to be submitted in Gradescope. Your write-ups should contain no more than one problem per page, i.e., if a homework assignment has 5 problems, you should upload at least 5 pieces of paper.
2. Each paper you turn in should have your name and the due date printed clearly at the top.
3. It is your responsibility to make sure that your homework is complete and all pages are accounted for.

My Email Policy: I love talking about mathematics and I always prefer to do it in person. For this reason, I like to, whenever possible, reserve email for logistical things. However, if you are unable to see me in person, please feel free to email me. I am here to help!

As my life is busy and I have many responsibilities, I usually only check and respond to email once per day and sometimes not at all on weekends. For this reason, I try to uphold the following 24-48 hour rule: If you send an email Sunday through Thursday, I will do my best to respond within 24 hours. If you send an email on Friday or Saturday, I will do my best to respond within 48 hours. If I do not respond within these windows, feel free to email me again as I may have missed it.

Academic Integrity: Each student in this course is expected to abide by the Cornell University Code of Academic Integrity.