Mathematics 633: Complex Analysis

Spring 2015 | W,F 1:25–2:40pm | Physics building 205

Professor: Lenny Ng
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Course web site: Assignments (etc.) for this course will be posted at
http://www.math.duke.edu/~ng/math633/.

Monday classes: I will have to be out of town on several days when we would normally have class (see the course web site for dates). Because of this, I would like to schedule make-up classes on Mondays in the same time slot (1:25–2:40) occasionally during the semester. Please let me know if you have a time conflict with this slot.

Textbook: The required text for this course is *Complex Analysis*, 3rd edition, by Lars Ahlfors. I am aware that the book is fairly pricey but if cost is an issue, please note that used copies are pretty readily available. Another good reference is *Functions of One Complex Variable* by John B. Conway; my approach to the course is informed by some mix of Ahlfors and Conway.

Office hours: TBA, and by appointment (set up in person or by email).

Prerequisites: Officially, familiarity with real analysis at the level of Math 532. More explicitly, you should be comfortable with the following:

- point set topology at the level of Chapter 3, section 1; it's also helpful if you're familiar with path homotopy and simple connectivity
- the Bolzano–Weierstrass Theorem, the Heine–Borel Theorem, the Lebesgue covering lemma
- uniform continuity, absolute and uniform convergence, the Weierstrass M-test
- the Arzela–Ascoli Theorem.

Alternate course: For undergraduates, we also offer Math 333 as an alternate course in complex analysis. Compared to Math 333, our course will be faster-paced and at a conceptually higher level. Typically students don't take both Math 333 and Math 633.

Homework: There will be weekly homework sets due in class on Fridays. I will hand the homeworks out in class a week before they're due, and post them to the web page. In general, late homeworks will not be accepted.

Exam: There will be a take-home exam due during finals period. For this exam, you will be allowed to consult your notes, the homework, and the book, but no other sources.

Grading: Your grade will be based on $2/3$ homework, $1/3$ final exam.

Topics to be covered: A general rule of thumb is that we'll be covering the material for the graduate qualifying examination in complex analysis; see

`http://www.math.duke.edu/graduate/qual/qualcompanal.html`

for the list of topics. For your convenience, I'm reproducing the list here.

- Complex differentiation, Cauchy-Riemann equations, power series, exponential and trigonometric functions
- Cauchy's theorem and integral formula, Cauchy's inequalities, Liouville's theorem, Morera's theorem, classification of isolated singularities, Taylor series, meromorphic functions, Laurent series, fundamental theorem of algebra, residues, winding numbers, argument principle, Rouché's theorem, local behavior of analytic mappings, open mapping theorem
- Harmonic functions, maximum principle, Poisson integral formula, mean value property
- Conformal mappings, linear fractional transformations, Schwarz lemma
- Infinite products, analytic continuation, multi-valued functions, Schwarz reflection principle, monodromy theorem
- Statement and consequences of Riemann mapping theorem and Picard's theorem.