College of the Holy Cross, Spring Semester, 2022
Math 305, Section 01 (Professor Hwang)
Course Information Sheet

Contact Information

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About the Course

Abstractly, complex analysis is nothing but calculus over the complex numbers. Concretely, complex analysis is deeply connected to geometry, algebra, analysis, topology, and a wide variety of applications (Fourier series and integrals, fluid flow in the plane, electrostatics, etc., etc.). The primary technical tools are multivariable calculus (partial derivatives, line integrals, Green's theorem), geometry, and a bit of limits and continuity.

The structure of the complex field guarantees that a function having one continuous derivative in an open set (a *holomorphic* function) has a convergent power series representation at each point (is *analytic*). Holomorphic functions therefore behave like the "nicest" real-differentiable functions. Further, a holomorphic function is automatically angle-preserving at each non-critical point (is *conformal*). Complex analysis therefore enjoys beautiful geometric properties. Finally, complex line integrals of holomorphic functions are invariant under continuous deformation of the contour of integration. The resulting *residues* carry useful analytic information.

The most important habit you can develop is to **keep up with the course**: Read the textbook actively ahead of class, and ask questions in class and office hours. Do not wait a few days to see me if you feel you're starting to fall behind.

Grading

My goals for you in the course are that you enjoyably extend your knowledge of calculus, and explain your work clearly in writing. The course grade has four components: weekly exercises, a proof portfolio, three in-class tests, and the final exam.

Written Work Each Friday I'll assign exercises from the book. These are due the following Friday and are worth 10% of your course grade. Some of these questions will be marked with a topic category. As the semester progresses, you'll submit final drafts of ten questions of your choosing, one from each topic category. These write-ups will count for 40% of your course grade. For detailed information, expectations, and grading, see the page `http://mathcs.holycross.edu/~ahwang/teach/305/prob.html`

Midterm Tests There are three midterm tests, to be held during class time on Friday, February 18, Friday, March 25, and Monday, May 2. The lowest two scores count for 10% of the course grade and the highest counts for 15%.

Final Exam The cumulative final exam is worth 15% of the course grade, and will be given during the May exam period at a time to be announced by the College.

Meeting Schedule

The following is the syllabus for the term. Please see the course web pages for a more detailed list of topics. Any substantial variations from this schedule will be announced by email or in class.

W	Jan 26	Section 1.1	Complex Numbers
F	Jan 28	Section 1.2	Geometry of the Complex Numbers
M	Jan 31	Section 1.3	Inequalities and Complex Numbers
W	Feb 2	Section 1.4	Topology of the Plane
F	Feb 4	Section 2.1	Limits and Continuity, I
M	Feb 7	Section 2.1	Limits and Continuity, II
W	Feb 9	Section 2.2	Complex Differentiability
F	Feb 11	Section 2.2	Holomorphic Functions
M	Feb 14	Section 2.3	The Cauchy-Riemann Equations
W	Feb 16	Section 2.4	The Identity Theorem
F	Feb 18		**Midterm 1**
M	Feb 21	Section 3.1	Möbius transformations
W	Feb 23	Section 3.2	The Projective Line
F	Feb 25	Section 3.3	Stereographic Projection
M	Feb 28	Section 3.4	Exponential and Circular Functions
W	Mar 2	Section 3.5	Logarithms and Roots
F	Mar 4	Section 4.1	Complex Integration
M	Mar 14	Section 4.2	Antiderivatives
W	Mar 16	Section 4.3	Cauchy's Theorem
F	Mar 18	Section 4.4	The Cauchy Integral Formula
M	Mar 21	Section 4.4	Winding Numbers
W	Mar 23	Section 5.1	The Cauchy Integral Theorem, II
F	Mar 25		**Midterm 2**
M	Mar 28	Section 5.2	Morera's Theorem
W	Mar 30	Section 5.3	The Fundamental Theorem of Algebra
F	Apr 1	Section 6.1	Harmonic Functions
M	Apr 4	Section 7.1-7.2	Sequences and Series
W	Apr 6	Section 7.3	Sequences of Functions
F	Apr 8	Section 7.3	Uniform Convergence
M	Apr 11	Section 7.4	Regions of Convergence
W	Apr 13	Section 8.1	Taylor Series
W	Apr 20	Section 8.1	The General Cauchy Integral Formula
F	Apr 22	Section 8.2	Zeros of Holomorphic Functions
M	Apr 25	Section 8.3	Laurent Series
W	Apr 27		Academic Conference
F	Apr 29	Section 9.1	Isolated Singularities
M	May 2		**Midterm 3**
W	May 4	Section 9.2	Residues
F	May 6	Section 9.2	Residues and Definite Integrals
M	May 9	Section 9.3	Rouché's theorem