Complex Analysis
MATH 6300 — Fall 2005

Peter Kramer

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Office hours: Tuesday 2–3 PM and Wednesday 3–4 PM
Website: `http://www.rpi.edu/~kramep/CA2005/ca2005.html`

Classes Mondays and Thursdays, 4:00-5:50 PM in Carnegie 112

Prerequisites Undergraduate level experience with mathematical analysis and complex variables

Requirements Homework assignments, which will be posted on the course website, and a final exam. The course grade will be determined by a 70% weighting of homework and a 30% weighting of the final exam. Students whose homework shows clear positive evidence of representing their own thinking will be allowed to skip the final exam and have their course grade determined completely (100%) by their homework scores.

Each assignment and final exam will be scored out of 100 points. Grading scale:

Average Score (rounded)	Grade
96–	A
90–95	A-
83–89	B+
76–82	B
70–75	B-
63–69	C+
56–62	C
50–55	C-
0–49	F

Late homework will be penalized 10 points per business day, and no credit will be awarded once solutions are posted (which can be as soon as the next class).

Academic Integrity You are encouraged to work in small groups on the homework assignments, but your actual solutions should be your own work. That is, you should feel free to discuss how to approach the problems, to consult on how to do certain calculations, or to check your results. But you should never be copying from other students. I will only give credit for work that demonstrates that you understand what you are doing. Therefore, be sure to explain all major steps, especially how you are setting up the problem. It is not necessary to provide detailed reports on routine calculations, but do at least explain in words what you are doing.

If you obtained assistance from anyone outside of the course or any written material beyond the lecture notes and three recommended texts for the course, you must explicitly acknowledge the source.

If I am unsure about a homework assignment being the student's own work, I will issue that student a warning. If the work is flagrantly corrupt or if homeworks fail to demonstrate the student's own thought after the first warning, I will award no credit for it. Clear violations of academic integrity will also be reported to the Dean of Students' Office.

Attendance You don't have to tell me if you miss a class. But don't expect me to spend much time giving you help with homework if you're not attending class.

Textbook All are optional.

- Ahlfors, *Complex Analysis*: nice, standard graduate text on complex analysis. Theoretically inclined (analysis and algebra).
- Ablowitz and Fokas, *Complex Analysis*: advanced applied mathematical treatment of complex analysis.
- Dettman, *Applied Complex Variables*: a relatively inexpensive textbook with a concrete, application-oriented style.

Course Objectives

- Provide a systematic, mathematical development of the essentials of complex variable and function theory.
- Describe some advanced applications of complex variables to problems in physics, etc., other than those which are covered in other classes. In particular, there is a "Complex Variables and Integral Transforms with Applications" (MATH 6640, Spring 2007) class which doesn't emphasize proofs but elaborates upon the use of contour integration in asymptotics and evaluating integrals. This "Complex Analysis" class will develop the mathematical foundations for contour integration (why it works) but not repeat in detail the applications which are covered in the other class. Rather, I will try to spend some time on other applications of complex variable theory, primarily to physics.
- Develop students' capacity for developing careful arguments and proofs. Actually complex analysis is a rather friendly field, and the proofs are not as technical as in other areas (such as real analysis, believe it or not). So if you learn the concepts and know what constitutes a sound argument, and can think about how to link the key concepts together, you can do the proofs.
- Cover some of the classical mathematically elegant aspects of complex variables theory which do not necessarily have much application.

Topics to be Covered I hope to also cover some more advanced topics and applications based on the class's interest.

- Algebra of Complex Numbers
- Geometry of Complex Numbers (including Stereographic Projection)
- Linear Fractional Transformations
- Analytic Functions
- Branch Cuts and Riemann Surfaces
- Complex Integrals
- Cauchy-Goursat Theorem, Cauchy Integral Formula, and Corollaries
- Taylor and Laurent Series in Complex Plane
- Singularities of Analytic Functions
- Analytic Continuation
- Padé Approximants
- Residue Theory for Integration
- Physical Resonances Represented in Complex Plane
- Landau Damping
- Rouché's Theorem and Applications
- Conformal Mapping, with Application to Fluid Flow