Math 132: General Course Outline

Catalog Description

132. Complex Analysis for Applications. (4) Lecture, three hours; discussion, one hour. Requisites: courses 32B, 33B. Introduction to basic formulas and calculation procedures of complex analysis of one variable relevant to applications. Topics include Cauchy/Riemann equations, Cauchy integral formula, power series expansion, contour integrals, residue calculus.

Textbook

T. Gamelin, *Complex Analysis,* Springer/Verlag.

Reviews & Exams

The following schedule, with textbook sections and topics, is based on 26 lectures. The remaining classroom meetings are for leeway, reviews, and a midterm exam. These are scheduled by the individual instructor. Often there are a review and a midterm exam about the end of the fifth week of instruction, plus a review for the final exam.

Schedule of Lectures

Lecture	Section	Topics
1	I.1-2	Complex numbers, polar form, complex multiplication, roots of complex numbers (much of this is review)
2	I.3	Stereographic projection
3-5	I.4-8	Elementary functions, including power, root, exponential, logarithm, and trigonometric functions
6	II.1-2	Complex derivatives, basic rules of differentiation
7-10	II.3-4	Cauchy-Riemann equations; inverse functions; harmonic functions; conformality; fractional linear transformations
11	III.1-3	Review line integrals and Green's theorem; harmonic conjugates
12-13	IV.1-2	Complex line integrals, ML-estimate, fundamental theorem of complex calculus
14-15	IV.3-6	Cauchy's theorem, Cauchy integral formulae, Liouville's theorem, Morera's theorem (statement only)
16-17	.	Catch up, review, midterm exam
18-21	V.1-7	Weierstrass M-test, power series, radius of convergence, operations on power series, order of zeros
22-24	VI.1-4	Laurent decomposition, isolated singularities, orders of poles and zeros, partial fractions decomposition
25-27	VII.1-4	Residue theory, applications of residue calculus to evaluate integrals
28	VIII.1	Argument principle, location of roots
29	.	Catch up, review for final exam

Comments

The students should be familiar with the elementary properties of complex numbers from high school. They have been introduced to the complex exponential function in Math 33B. They should be familiar with power series, including radius of convergence, the ratio and root tests, and integration term by term.

The idea of gluing sheets together at branch cuts to form a surface is important, but it can be omitted at this stage. At most it should be treated only at an intuitive level, to introduce the idea to the students and to arouse their interest.

The idea of conformality can be treated lightly if short on time. The results of the section on conformality are used primarily to see that fractional linear transformations map orthogonal circles to orthogonal circles.

With respect to uniform convergence, the only thing that is really needed is the Weierstrass M-test, together with the integration term by term of a uniformly convergent series of functions.

The material in Section VIII.1 on the argument principle is important to electrical engineers and should not be omitted. Rather omit Section VII.3 if short of time at the end of the course.

Outline update: T. Gamelin, 3/04

NOTE: While this outline includes only one midterm, it is strongly recommended that the instructor considers giving two. It is difficult to schedule a second midterm late in the quarter if it was not announced at the beginning of the course.