Complex analysis, lecture 2: syllabus

Spring 2026

Time and location: 3 - 4 PM Mondays, Wednesdays, and Fridays in Etcheverry 3109
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Office hours: TBD
Reader: TBD

Welcome to complex analysis! In this course, we will study what is widely considered to be some of the most beautiful mathematics you are likely to encounter in an undergraduate course, if not beyond. Complex analysis is full of miraculous results with applications to geometry, algebra, and number theory, among others, as well as to physics, engineering, and many other fields outside of pure mathematics.

Summary

The material for the course can be grouped into four main areas:

- holomorphic (i.e. complex analytic) functions and their basic properties;
- complex integration and its applications;
- series methods and the residue theorem;
- further topics towards complex analysis and geometry.

By the end of the course, students should have a good working understanding of holomorphic functions; understand the meaning of and be able to compute complex integrals, and understand their utility in complex analysis; be able to use the residue theorem to compute complex and real integrals that would otherwise be impossible; and be able to apply complex analysis to areas such as hyperbolic and complex geometry.

A more detailed course outline can be found at the end of this document.

Prerequisites

The official prerequisite for this course is Math 104, Introduction to Analysis. This will not be rigorously enforced: if you have not taken Math 104 but feel you have sufficient background to do well in this class, I will trust your judgment. What is really needed is a good understanding of calculus, some familiarity with analysis, and a certain level of mathematical maturity. If you are not sure whether you have the prerequisites, email me or come to my office hours.

Textbook

We will loosely follow *Complex Analysis* by Theodore Gamelin. You do not need to purchase it: you may find it helpful to read relevant sections of the book before class (readings will be suggested), but lecture notes will also be posted, and any problems drawn from the book will also be posted on the course website.

Course structure

This course will be taught via "standards-based learning," the central idea of which is that there is a set of objectives which you are here to learn, and the class should be taught in such a way as to optimize the amount of these (both in number and degree) that you learn by the end of the semester, and graded based on how many you have learned to a satisfactory standard. Concretely, this means that both the class structure and grading may be different from what you are used to:

- Your grade will be determined by the number of objectives for which you have demonstrated achievement. Higher grades also require a certain number of "challenge points" (see below for a detailed table).
- In order to demonstrate achievement of each objective, you need to successfully solve problems on that topic **both** on the homework **and** on the exams.
- If you don't manage to solve a homework problem correctly on the first attempt, **you can re-attempt it without penalty**, with no limit on the number of reattempts.
- Approximately a week after each exam, there will be an in-class "retest" with more questions on the same topics, as well as on any earlier ones you may have missed. Successful solutions to problems on retests will count just as well as those on exams, so in a very real sense incorrect solutions don't count: you just need to be able to solve enough problems on each topic over the course of the semester.

Each problem will be graded either S (successful), P (partially successful), or N (not yet successful), with comments to help you improve your future work as needed. Your mark for each objective will be based on your best two exam problems for that objective and all but one of the homework problems which target that objective, dropping the lowest homework mark for each objective.

To get an S on the objective, you need two S's on exams and all S's on the homeworks, not counting the dropped problem; to earn a P, you need at least half that number. (So for example if there are four homework problems targeting a given objective, to achieve the objective to S-level you would need two S's on the exam problems and three S's on the homework problems; to achieve it to P-level, you would need one S on the exam and two S's on the homework, since $\frac{4-1}{2} = 1.5$.) A P on either a homework or exam problem counts as half of an S (so two P's on the exam and three P's on the homework would also earn you the objective to level P).

Examples of S-level, P-level, and N-level work are posted on the website. Work which is significantly incomplete, does not address the question, or is illegible to the grader will receive a mark of N, and may receive fewer or no comments.

To keep the workload manageable for all of us, **you are limited to re-attempting at most three homework problems per week**, where weeks end at 11:59 PM Monday nights. **You cannot save up re-attempts for later in the semester**, so there is no reason to not re-attempt early on.

Challenge points

In addition to the objectives, higher grades in this class also require you to earn a certain number of challenge points over the course of the class. You can earn challenge points by solving challenge problems on exams or retests, and possibly also on some homeworks; these are harder problems which may require you to use the tools and concepts you learn to go beyond what was illustrated in class. There may also be other opportunities to earn challenge points.

It is not expected that anyone will earn every challenge point available; there will be many more points available than are necessary to earn an A+. You should prioritize demonstrating achievement of the objectives over earning challenge points, as you can still achieve a good grade in this class with few or no challenge points, but cannot without achieving most of the objectives.

Exams

There will be three midterms and a final exam, tentatively scheduled for February 13, March 16, April 20, and May 13. These are closed-book, with no calculators or outside resources, except that you may bring a note sheet. For any exam problem on which you are dissatisfied with your grade, you should review the feedback carefully and target that objective on the retest.

Retests will not have exactly the same questions as the exams, but will be fundamentally similar. The hope is that you can take the exam as a relatively low-stress first opportunity to try the problems, and then on the retest you'll have more time to focus on the topics that give you more difficulty, or on the challenge problems. This does make for quite a lot of testing; on the other hand, it makes the stakes for any given test rather low.

The final exam will have the same format as the midterm exams, except for being longer, and serves as your last chance to demonstrate each objective.

In general, since the retests can fully replace exams, makeup exams will not be available; however in exceptional circumstances contact me **beforehand**, or as soon as possible afterwards in case of illness, and we can try to work something out

Homework

Homework is assigned weekly, typically due on Mondays by the end of the day. You should expect to spend between 3-9 hours on these. Collaboration is encouraged, but everyone should write their own solutions; **write on your homeworks anyone you have worked with**. The contribution from each collaborator should be roughly equal: if you find yourself frequently doing more or less than your collaborators, consider finding a different group.

Unless otherwise specified, you may use any and all resources (again, **citing any sources you have used**), including any textbooks you have access to, your classmates and friends, office hours (you should come to these!), or the internet, with the following exceptions:

- do not post the problem on any website to be answered by someone else;
- do not use computer algebra systems or their equivalents (e.g. WolframAlpha, SageMath, Mathematica, integral-calculator.com, generative AI, etc.) to do your compu-

tations unless otherwise specified. That said, these are all useful resources I encourage you to familiarize yourself with for any purpose other than homework for this class (and naturally any other classes with similar policies).

The reason for these exceptions is that while using other resources does not prevent you from learning from doing computations, outsourcing those computations entirely does.

For any homework problem on which you are dissatisfied with your grade, you should carefully review the feedback and reattempt the problem, and resubmit it via the resubmission assignment for the current week on bCourses. Resubmissions made in the incorrect place (e.g. the original assignment) may not be graded, or graded late. You can submit reattempts once per week for each problem, up to a maximum of three problems per week; if your reattempt is not successful, you can continue to reattempt the same problem as many times as needed through the end of the semester. The last day to submit reattempts is the last day of classes (Friday, May 1). Keep in mind that as problems pile up, the three-problem limit will become more and more of an issue towards the end of the semester, so it is best to stay on top of revisions.

We will attempt to have all homework graded within one week of its submission. Late homework may be graded late.

Projects

In addition to the regular objectives for this class, the final one is reserved for "special topics." While we will cover some material in class for this objective, and it can be assessed via homework and exam problems as usual, you may also choose to instead do a **optional** project on a topic of your choice, which would replace both the homework and exam portion for that objective. Strong projects can also earn challenge points. More details on the project will be posted later in the semester.

Grading

Your grade will be determined by the number of objectives you achieve, together with challenge points. There are 8 objectives, listed below.

An objective at level P counts as half an objective; so for example if you have achieved six objectives to level S, three to level P, and one to level N, then you would be considered to have $6 + 3 \cdot \frac{1}{2} = 7.5$ objectives.

A- or B-level grades also require challenge points in addition to meeting objective totals. Thus the grade requirements are as follows:

Grade	Objectives achieved	Challenge points
A	10	≥ 20
B	≥ 8	≥ 5
C	≥ 6	≥ 0
D	≥ 4	≥ 0

Your grade will be the highest for which you've fulfilled both requirements. A grade of F will be assigned if the requirements for a D are not met.

Plus or minus modifiers will be added depending how close you are to the next grade up (or down).

I reserve the right to modify this grading scheme over the course of the semester, but only ever in your favor (e.g. I could change the requirements for a B to only requiring 3 challenge points instead of 5, but will not change it to requiring 10).

The objectives are as follows.

(1) Complex numbers, algebra, and functions: you understand and can manipulate and use complex numbers and functions, including multivalued functions.
(2) Analytic functions and the Cauchy–Riemann equations: you know the definition of an analytic function, and can derive and apply the Cauchy–Riemann equations to check if a given function is analytic.
(3) Harmonic functions: you know the definition of harmonic functions, can check if and where functions are harmonic and find harmonic conjugates, and understand the relationships with analytic functions and characterizations of harmonic functions.
(4) Complex integration: you can set up and evaluate contour integrals in the complex plane, and know and can use their basic properties and bounds.
(5) Cauchy's integral theorem and formula: you can state and prove Cauchy's integral theorem, apply it to prove Cauchy's integral formula.
(6) Consequences of Cauchy's theorem and formula: you can apply these results to prove theorems such as Liouville's theorem, Morera's theorem, and the fundamental theorem of algebra.
(7) Power series expansions of analytic functions: you can express analytic functions on disks (including "at infinity") as power series, compute their radii of convergence, and understand how analytic continuation can be used to define certain analytic functions outside their radius of convergence.
(8) Laurent series: you can express analytic functions on annuli as Laurent series, classify their isolated singularities, and describe the behavior of analytic functions near each type.
(9) The residue theorem: you can compute residues at isolated singularities and can use the residue theorem to evaluate contour integrals and certain real integrals, including integrands with branch points.
(10) Special topics, e.g. the argument principle, conformal maps, hyperbolic geometry, the Dirichlet problem, etc.

Course policies

Attendance

Attendance is not mandatory, in the sense that I will not be taking attendance and it is not part of your grade, but it is expected as a part of the class. Empirically, students tend to do better when they come to class. However if you need to miss a class for any reason, **you do not need to inform me.**

Deadlines and extensions

If you are unable to turn in your homework by the official deadline, please contact me **at least 24 hours in advance** with a request for an extension; you must specify when you would like the new deadline to be. I expect to grant all such requests, within reason, but try not to do this more than you have to.

Late homework may be marked late, potentially more than a week even after it is submitted, since the grader will need to prioritize new work. Late homework submitted without an extension may initially be treated as missing and so receive the mark of N; it will then cost reattempts to grade for the following week.

Technology requirements

You do not need any particular technological devices for this class other than a writing implement (for exams, at least); in particular you do not need a calculator. However, many materials will by default only be made available online, via bCourses, and homework submissions will also be online. If this presents a difficulty for you contact me and I'll make the materials available on paper as needed.

COVID-19 policies

Classes will be in person, but please do not come to class if you are feeling sick or test positive: lecture notes will be available, and I will be happy to help you make up the material. If you are sick and unable to do the work for a prolonged period, contact me to work out a way to make up the work: it is important to do the work for each section of the class, since that is the way to learn the material and later portions of the class will build on the earlier ones, but when necessary we can figure out how to reduce the workload to be manageable without having to work through illness. Similarly, please do not attend exams if you are ill or have recently tested positive for COVID-19: we will figure out solutions if these situations arise.

Remote teaching

In emergencies, class may take place online rather than in person; in this case lectures will be streamed via Zoom. This may also occur for one or two classes if I am traveling, but will not be a regular occurrence outside of emergencies.

Accessibility and accommodations

Please let me know if there is anything I can do to make this course more accessible to you, or if aspects of the course are excluding you, and we can work together to develop strategies to improve the class. If you think you may need official accommodations, such as extended time on exams, I encourage you to contact the Disabled Students' Program for an accommodation letter.

Tentative course outline

As promised:

Jan. 21, 23	I.1-4	Complex numbers and geometry
Jan. 26, 28, 30	I.5-8	Complex functions
Feb. 2, 4, 6	II.1-3	Analytic functions
Feb. 9, 11, 13	II.4	More analytic functions, exam 1
Feb. 18, 20	III.1-2, II.5	Line integrals and harmonic functions
Feb. 23, 25, 27	III.3-5, X.1-2	The mean value property and maximum principle, the Dirichlet problem
Mar. 2, 4, 6	IV.1-4	Complex integration, Cauchy's integral theorem and formula
Mar. 9, 11, 13	IV.5-8	Applications
Mar. 16, 18, 20	V.1-3	Exam 2, power series
Mar. 23 - 27		Spring break
Mar. 30, Apr. 1, 3	V.4-7	Series expansions of analytic functions
Apr. 6, 8, 10	V.8, VI.1-2	Analytic continuation, Laurent series
Apr. 13, 15, 17	VI.3-4, VII.1-4	Singularities and the residue theorem
Apr. 20, 22, 24	VIII.1-2	Exam 3, the argument principle
Apr. 27, 29, May 1	X.2	Other topics and review
May 4 - 8		RRR week

Here the middle column gives the corresponding chapters in Gamelin's *Complex Analysis* for those who would like to follow along there. Note that this is an approximation, and the precise content covered may differ from this outline.