MATH 205A: COMPLEX ANALYSIS
COURSE SYLLABUS
UC DAVIS, WINTER 2025

1. Summary

- Course instructor: Dan Romik
- Course lectures: Tuesdays and Thursdays 11:00-12:20, MSB 3106
- Office hours: exact time Tuesdays and Thursdays, 1:15-1:45, MSB 2218
- Final exam date, time and place: Thursday March 20, 2025, 8:00-10:00 am, MSB 3106 (as listed on the UC Davis Registrar's final examinations schedule)
- Biweekly problem session: Tuesdays 4:10-5 pm, on Zoom. Connect with this link: https://ucdavis.zoom.us/j/94127079182?pwd=3FVptleczkyL4n6VaS2b9xaMs0jcal.1

  The first problem session meeting will take place on January 14, 2025. Subsequent meetings will take place every two weeks.

2. Course prerequisites

- Undergraduate complex analysis (UC Davis Math 185A, or equivalent).

3. Course textbook

- D. Romik, Topics in Complex Analysis. De Gruyter, 2023.

  The book is available for purchase or for free download. See the book web page for details:
  https://www.math.ucdavis.edu/~romik/topics-in-complex-analysis/

4. Course description and objectives

The course is the first in the two-quarter graduate sequence in complex analysis. The course aims to revisit the material from undergraduate complex analysis and a select number of more advanced topics, emphasizing the beauty of the theory and its applicability and connections to other areas of mathematics.

Learning objectives

Document version: January 9, 2025 (updated with information about office hours and the biweekly problem session)

(1) To relearn the material from undergraduate complex analysis at a higher level of rigor and depth.

(2) To learn a select number of more advanced topics, including both theory and applications. One highlight will be a proof of the *prime number theorem*, one of the most celebrated results in mathematics.

(3) To improve your general abilities as a pure mathematician, including:
   - Proof writing and mathematical exposition skills
   - Proof reading and critiquing skills
   - Understanding of the mathematical analyst's way of thinking, e.g., ϵ-δ arguments, manipulation of inequalities.
   - Optional, but strongly recommended: mathematical typesetting (i.e., LaTeX) skills.

Detailed list of topics: [estimated class time in brackets]

- The fundamental theorem of algebra: three "proofs from the book" [**1 lecture**]
- Basic complex analysis: differentiation, analytic and harmonic functions, the Cauchy-Riemann equations, power series [**3 lectures**]
- Integration and Cauchy's theorem: contour and integrals, the Goursat, Morera and Cauchy theorem, the Cauchy integral formulas [**4 lectures**]
- Consequences of Cauchy's theorem: the logarithm function, Liouville's theorem, the maximum principle, Rouché's theorem, the argument principle, principle of analytic continuation [**4 lectures**]
- Simply-connected regions and the general version of Cauchy's theorem [**1 lecture**]
- The Euler gamma function and its properties [**2 lecture**]
- The Riemann zeta function and its properties [**3 lectures**]
- The prime number theorem [**2 lectures**]
- Introduction to conformal maps, introduction to asymptotic analysis, or other topics as time permits

5. Grading policy

The course grade will be assigned based on **two homework assignments (25%)** and an **in-class final exam (75%)**, with the option of doing a **project for extra credit**.

- **Homework:** homework will be assigned every week. The homework will not be collected or graded except for two of the weekly homework assignments. Those mandatory assignments will be graded and critiqued in detail by me for correctness and the quality of the presentation, and will count for 25% of the final course grade, with the

higher-graded assignment counting for 15% and the lower-graded one counting for 10%.

- **Exam:** the final exam will count for 75% of the final course grade.
- **Extra credit project option:** you have the option to potentially earn an increase to your final course grade if you submit a digitally typeset (using LaTeX or similar) project of 5–10 pages on an advanced complex analysis topic that was not covered in the class. This is subject to the following terms:
  - If you qualify for the grade increase, the increase to your final grade from the grade calculated from the exam and mandatory homework will be of precisely one step in the grade ladder (i.e., an A- will turn into an A, a B+ will turn into an A-, a B will turn into a B+).
  - The grade increase will apply only if your final grade computed without the project was a B or higher. B- or lower grades do not qualify for the increase.
  - For a grade increase from an A to an A+, you will qualify for the increase if the grade you earn for your final project is an A- or higher.
  - For other grade increases (B to B+, B+ to A-, A- to A), you will qualify for the increase if the grade you earn for your final project is a B or higher. (If the project grade is lower than a B, I will return the project to you with some feedback and give you an opportunity to improve it and resubmit so that you can qualify for the final grade increase.)

  If you are thinking of doing a project, please coordinate with me in advance your choice of topic. I will suggest in class at some point options for project topics (from the textbook and/or other sources) and a timeline for the writing and submission of projects.

6. Ethics and AI usage policy

General ethics policy. You are expected to comply with the UC Davis Code of Academic Conduct. More specifically, my expectations are that any work you submit as part of the homework assignments and optional project must:

i. be physically written/typed by you;
ii. be written in your own words, except for permitted use of AI assistants as explained below; and
iii. represent that you have taken a significant intellectual part in its creation and understand what you have written, unless explicitly specified otherwise. (I.e., you may work on a problem in collaboration with peers as long as you make a sincere effort to solve it yourself, and once a solution has been found by the group you should make sure that you understand it if you are submitting it as part of the assignment, or explicitly clarify which part you are not sure you understand.)

AI assistants. If you wish to use AI assistants (ChatGPT, Claude etc) to improve the quality of your writing, you may do so. But please do so *responsibly*. What I mean by this is:

- Do not ask the AI to solve a problem for you. Instead, first solve it yourself (or at least partially solve it), write the solution *in your own words*, and then ask the AI to suggest improvements. If you skip this step, you will miss a critical part of the learning and mathematical development that the homework is designed to stimulate.
- Use the opportunity to *learn* from the changes suggested by the AI assistant. That is, compare what the AI wrote to the initial draft you gave it and think about why the suggested changes are improvements (or indeed if they are genuine improvements—it is completely possible for AI assistants to spout incorrect nonsense).
- Optionally, mention in the assignment you are submitting that you used an AI assistant, and include a brief note on the scope of the changes credited to the AI. I won't take off points if you don't mention this, and I won't take off points if you do mention it. I simply encourage it, since giving credit to others (whether people or AI entities) is a good habit to develop, and the intellectual honesty that it fosters will serve you well in your future math career.
- Needless to say, you assume full responsibility for the solutions you submit. If you submit content suggested by AI and it is incorrect, do not complain later that you were not given credit or that your grade was marked down.

7. Students with disabilities

Any student with a documented disability (e.g., physical, learning, psychiatric, vision, hearing, etc.) who needs to arrange reasonable accommodations must contact the Student Disability Center (SDC). Faculty are authorized to provide only the accommodations requested by the SDC. If you have any questions, please contact the SDC at 530-752-3184 or sdc@ucdavis.edu.