MATH 205A: COMPLEX ANALYSIS
COURSE SYLLABUS

UC DAVIS, WINTER 2020

1. Summary

- Course instructor: Dan Romik
- Course lectures: MWF 1:10-2:00, Bainer 1134
- Office hours: M 9:30-10:30, MSB 2218
- Biweekly problem session: M 5:10-6:30 (tentative), MSB 2112, every other week starting January 13
- Final exam date, time and place: TBA

2. Course prerequisites

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

3. Course textbook

- The course will be based to a large extent on the book *Complex Analysis*, by E. M. Stein and R. Shakarchi (Princeton University Press, 2003).
- The textbook will be supplemented by my own text, *Complex Analysis Lecture Notes*, available to download from the course webpage.
- Additional recommended reading will be suggested for some of the topics covered.

4. Course description and learning 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

(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 main highlight will be a proof of the prime number theorem, one of the most celebrated results in mathematics.

Document version: January 6, 2020

(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 lectures]**
- The Euler gamma function and its properties **[2 lecture]**
- The Riemann zeta function and its properties **[3 lectures]**
- The prime number theorem **[2 lectures]**
- Asymptotic analysis, the saddle-point method, Stirling's formula. **[3 lectures]**
- Additional topics as time permits

5. Grading policy

The course grade will be assigned based on **two homework assignments (20%)** and an **in-class final exam (75%)**, with the option of doing a **project for extra credit**.

- **Homework:** homework will be assigned every week out of the problems section at the end of the lecture notes, additional problems from the textbook and miscellaneous other sources.

  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 policy

Any work submitted as part of the homework assignments and optional project must: (i) be physically written/typed by you; (ii) be written in your own words; 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 must 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.)

Failure to adhere to these guidelines would be considered by me as a violation of the UC Davis Code of Academic Conduct and warrant, at minimum, a failing grade in the assignment in question and a referral to Student Judicial Affairs.

To put the above in more human terms: don't cheat; treat me and your fellow students as you would like to be treated.

7. Students with disabilities

If you are entitled for some form of accommodation, e.g., based on a disability, please let me know so that we can discuss any relevant logistical details.

Note that, excepting minor things that are at my discretion, for most forms of accommodation such as extra time on the final exam I am only allowed to provide accommodations that are explicitly approved by the campus's Student Disability Center. So make sure to discuss your situation with them in a timely manner.