# MATH-UA.0282-001: Functions of a Complex Variable

Spring 2021

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|---|---|---|---|
| **Instructor** | Michel Pain | **Lecture** | TR 3:30–4:45pm |
| **Email** | michel.pain@nyu.edu | **Classroom** | Zoom (recorded) |
| **Office hours** | TR 9:00-10:00am | | |
| **Teaching Assistant** | Wenjun Zhao | **Recitation** | F 09:30–10:45am |
| **Email** | wenjun.zhao@nyu.edu | **Classroom** | Zoom (recorded) |
| **Office hours** | M 4:30-5:30pm | | |
| **Teaching Assistant** | Yue Huang | **Recitation** | F 3:30–4:45pm |
| **Email** | yh3095@nyu.edu. | **Classroom** | Zoom (recorded) |
| **Office hours** | TBA | | |

## Course Goals

This course is a one-semester introduction to complex analysis. The topics included are: complex numbers, differentiation of complex functions, Cauchy-Riemann equations, analytic functions, Cauchy's theorem and the Cauchy integral formula, Taylor series and Laurent series, singularities, residues, analytic continuation. The course will be mainly proof based, up to some calculus results taken as granted. Lectures will be held on Zoom, but recordings will be available shortly after class, and I will upload the lecture notes on NYU Classes.

**Prerequisities:** MATH-UA 123 Calculus III or MATH-UA 213 Math for Economics III (for Economics majors) plus one higher level course such as MATH-UA 140 Linear Algebra with the grade of C or better.

## Textbook

The textbook for the course is *Complex Variables and Applications*, by James W. Brown and Ruel V. Churchill (9th edition, but previous editions are fine). Readings associated to each lecture are indicated on the calendar; you are encouraged to read these before coming to class. They contain in particular additional examples and exercises.

## Assessments

Your course score will be determined as the following weighted average:

- Homework: 20%
- Quizzes: 15%
- Midterm 1: 20%
- Midterm 2: 20%
- Final Exam: 25%

This score will be converted to a letter grade with the values below as cutoffs. These cutoffs might be adjusted at the end of the semester (the so-called "curve"), but only in the downward direction (to make letter grades higher).

| A | A− | B+ | B | B− | C+ | C | D | F |
|---|---|---|---|---|---|---|---|---|
| $[100, 93]$ | $(93, 90]$ | $(90, 87]$ | $(87, 83]$ | $(83, 80]$ | $(80, 75]$ | $(75, 65]$ | $(65, 50]$ | $(50, 0]$ |

## Quizzes (15%)

Quizzes will be available on **Gradescope**, at least 48 hours before Tuesdays class start time. They will include relatively basic questions concerning the lectures of the previous week. Students can select any 20 minute interval of convenience during this window to complete the quiz. Your response should be written individually without consulting resources other than the textbook and class notes. There will be no makeup quizzes (no exceptions). Two quiz scores will be dropped from your course grade.

## Homework (20%)

HW will be due each Thursday, at 11pm via **Gradescope**. They will include more advanced problems, mainly on the topics of the lectures of the previous week. Grading of homework will be based on clarity and correctness of mathematical arguments: you should detail the steps of your reasoning and cite theorems and definitions used. In fairness to graders and other students in the course, late homework will not be accepted (no exceptions). One HW score will be dropped from your course grade.

Students are encouraged to work together, but submitted assignments must be written individually in your own words. Submitting two very similar sets of solutions is a violation of academic integrity and will be disciplined by the university. The best way to ensure this does not happen is to write your solutions separately.

## Exams (65%)

There will be two midterm exams and one final exam. The midterm exams will be taken in class and last one hour. The final exam will be taken after the end of classes. For students in time zones where the class meeting takes place during the night, another session will be scheduled. During the exam, you will be allowed to consult the textbook and class notes (including exercises and HW solutions), but no other resources. Topics included are indicated below: this includes only the parts of the chapters covered in class.

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|---|---|---|
| Midterm 1 (20%) | March 9 | Chapters 1–3 |
| Midterm 2 (20%) | April 6 | Chapters 1–4 |
| Final Exam (25%) | TBA | Chapters 1–6 |

There will be no accommodation for missed exams, except in the cases of illness, observance of religious holidays and school-sanctioned events (such as athletics). In the case of observance of religious holidays or school-sanctioned events, you must make arrangements to make up missed work **at least one week in advance**. In the case of illness, the instructor should be warned **before** the exam starts and you must present a detailed letter from a physician/health care provider.

# Communication

Main announcements concerning the class will be made through NYU Classes. In addition to this, we will use the platform **Campuswire** for class-related communication. You will be able to post messages publicly so that everyone can see or to send direct messages to the instructor. If you have questions about the homework, or a general question about the lecture material, please post this publicly. This way, everyone in the class will benefit from the answer as it is likely that several people have a similar question. If you see a question for which you know or have an idea about the answer, please do post

to respond. The instructor will monitor the posts frequently and indicate whether they are correct. Even if they aren't, it's ok! It's much better to have an incorrect idea and find out soon, than to keep thinking the incorrect idea and make mistakes on the test.

## Honor Code

We value integrity and do not tolerate academic dishonesty. You are expected to uphold academic integrity as specified by the university and the College of Arts and Sciences (`https://cas.nyu.edu/content/nyu-as/cas/academic-integrity.html`).

## Other Course Policies

Your safety and success in the course is important to me. For security purposes, students must join class meetings on NYU Classes/Zoom. All in-person meetings must meet current physical distancing and face covering guidelines. Students are expected to contribute to a positive learning community: arrive on time to class, participate meaningfully in class and learn from one another. I am available during office hours to discuss course material and by appointment to address personal matters. Peer tutoring is available to all students by the Math Department and University Learning Center. Students with disabilities should contact the Moses Center to make arrangements for academic accommodations as soon as practicable. If you are in a situation that is adversly impacting your coursework, contact me and your academic advisor immediately so we can make a plan to move forward.

# Calendar (preliminary version)

| Week | Day | Date | Textbook | Topics | Assignments |
|---|---|---|---|---|---|
| 1 | Th | 01/28 | Chap1: 1–4 | Complex Numbers | |
| | F | 01/29 | | **No recitation** | |
| 2 | Tu | 02/02 | Chap1: 5–7 | Conjugate and Exponential Form | Quiz 1 |
| | Th | 02/04 | Chap1: 8–11 | Properties of the Exponential and Roots | HW 1 |
| | F | 02/05 | | Recitation | |
| 3 | Tu | 02/09 | Chap2: 13–15 | Functions and Limits | Quiz 2 |
| | Th | 02/11 | Chap2: 16–18 | Limits and Continuity | HW 2 |
| | F | 02/12 | | Recitation | |
| 4 | Tu | 02/16 | Chap2: 19–21 | Differentiation and Cauchy-Riemann Equations | Quiz 3 |
| | Th | 02/18 | | **No class (Legislative Monday)** | HW 3 |
| | F | 02/19 | | Recitation | |
| 5 | Tu | 02/23 | Chap2: 22–23,25–27 | More on C-R Equations and Analytic Functions | Quiz 4 |
| | Th | 02/25 | Chap3: 30–34 | The Exponential and Logarithmic Functions | HW 4 |
| | F | 02/26 | | Recitation | |
| 6 | Tu | 03/02 | Chap3: 35–37 | The Power and Trigonometric Functions | Quiz 5 |
| | Th | 03/04 | Chap4: 41–42 | Integral Along Real Line | HW 5 |
| | F | 03/05 | | Recitation | |
| 7 | Tu | 03/09 | **Chapters 1 to 3** | **Midterm 1** | |
| | Th | 03/11 | Chap4: 43–45 | Contour Integral | |
| | F | 03/12 | | Recitation | |
| 8 | Tu | 03/16 | Chap4: 45–46 | Contour Integral and Branch Cut | Quiz 6 |
| | Th | 03/18 | Chap4: 47–49 | Upper Bounds and Antiderivatives | HW 6 |
| | F | 03/19 | | Recitation | |
| 9 | Tu | 03/23 | Chap4: 50–51 | Cauchy–Goursat Theorem | Quiz 7 |
| | Th | 03/25 | Chap4: 52–53 | Simply and Multiply Connected Domains | HW 7 |
| | F | 03/26 | | **No recitation ("Springbreak")** | |
| 10 | Tu | 03/30 | Chap4: 54–56 | Cauchy Integral Formula | Quiz 8 |
| | Th | 04/01 | Chap4: 57–59 | Consequences of Cauchy Integral Formula | HW 8 |
| | F | 04/02 | | Recitation | |
| 11 | Tu | 04/06 | **Chapters 1 to 4** | **Midterm 2** | |
| | Th | 04/08 | Chap5: 60–61 | Series | |
| | F | 04/09 | | Recitation | |
| 12 | Tu | 04/13 | Chap5: 62–64 | Taylor Series | Quiz 9 |
| | Th | 04/15 | Chap5: 65–68 | Laurent Series | HW 9 |
| | F | 04/16 | | Recitation | |
| 13 | Tu | 04/20 | Chap5: 69–71 | Power Series | Quiz 10 |
| | Th | 04/22 | Chap6: 74–75 | Isolated Singularities and Residues | HW 10 |
| | F | 04/23 | | Recitation | |
| 14 | Tu | 04/27 | Chap6: 76–77 | Cauchy's Residue Theorem | Quiz 11 |
| | Th | 04/29 | Chap6: 78–81 | Classifications of Singularities | HW 11 |
| | F | 04/30 | | Recitation | |
| 15 | Tu | 05/04 | 82, 72, 28 | Zeros and Analytic Continuation | Quiz 12 |
| | Th | 05/06 | | Review | HW 12 |
| | F | 05/07 | | Recitation | |
| 16 | TBA | TBA | **Chapters 1 to 6** | **Final Exam** | |