

MAT334H1S: Complex Variables
Winter 2025
University of Toronto

I. Instructor and Teaching Assistants

Course Instructors

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I. Course Overview

Course Description

Theory of functions of one complex variable, analytic and meromorphic functions. Cauchy's theorem, residue calculus, conformal mappings, introduction to analytic continuation and harmonic functions.

Prerequisites

MAT223H1/ MATA23H3/ MAT223H5/ MAT240H1/ MAT240H5, MAT235Y1/ MAT235Y5/(MAT232H5, MAT236H5)/(MATB41H3, MATB42H3)/ MAT237Y1/(MATB41H3, MATB42H3, MATB43H3)/ MAT237Y5/ MAT257Y1

Exclusion: [MAT354H1](#)

Course Objectives

To obtain a working familiarity with the theory of functions of one complex variable, analytic and meromorphic functions. To be able to understand and apply Cauchy's theorem, residue calculus and conformal mappings.

Textbooks/ Course Readings

Stephen D. Fisher. *Complex Variables* 2nd Edition (Dover Books on Mathematics)

Mark J Ablowitz and Athanassios S. Fokas. *Introduction to Complex Variables and Applications* 2nd Edition (Cambridge Texts in Applied Mathematics)

Neither textbook is required, but it is recommended to have access to at least one of them. Ablowitz and Fokas is available online through the U of T library.

How this course is organized:

This course consists of two separate lecture sections that will cover common content and share examination materials. Each section has a two hour lecture and a one hour lecture each week. Tutorials will begin January 13 and students will attend one tutorial section per week; there are several different tutorial sections available. The course will be organized through Quercus. Examinations and quizzes will be graded on Gradescope.

Technical Requirements *(recommended if the course is an online course, modify as needed)*

In order to participate in this course, students will be required to have:

- Reliable internet access. It is recommended that students have a high speed broadband connection (LAN, Cable, or DSL) with a minimum download speed of 5 Mbps.
- A computer satisfying the minimum technical requirements
(<https://www.vicprovoststudents.utoronto.ca/student-policies-guidelines/tech-requirements-online-learning/>)

If you are facing financial hardship, you are encouraged to contact your college or divisional registrar (<https://future.utoronto.ca/current-students/registrars/>) to apply for an emergency bursary.

II. Evaluation/ Grading Scheme

Mark Breakdown

Assessment	Details
Quizzes	There will be 4 quizzes. Quizzes will be written during tutorials. You must write your quiz in the tutorial section in which you are registered. The lowest mark will be dropped.
Term Tests x 2	There will be 2 term tests of approximately 95 minutes. They will be written during class time. You must write your term test during the lecture section in which you are registered.
Final Assessment	There will be a final assessment written during the final examination period.

Your grade in the course will be the maximum of the following grading schemes:

- | | |
|----------|---|
| Option 1 | 10% best three quizzes, 20% TT1, 20% TT2, 50% Final |
| Option 2 | 10% best three quizzes, 20% TT1, 70% Final |

- Option 3 10% best three quizzes, 20% TT2, 70% Final
Option 4 10% best three quizzes, 90% Final

Quizzes

There will be 4 quizzes, of which the quiz with the lowest grade will be dropped. The quizzes will be written during tutorial sections. You must write the quiz during the tutorial section in which you are registered. Students writing quizzes in tutorial sections in which they are not registered will automatically receive a zero. The tentative weeks of the quizzes are:

- Quiz 1: Jan 20-24
Quiz 2: Feb 10-14
Quiz 3: Feb 24-28
Quiz 4: March 24-28

Term Test

There will be two term tests consisting of approximately 95 minutes each. They will be written during lecture section. You must write the term test in the lecture section in which you are registered. Students writing the term test in the lecture section in which they are not registered will receive a zero. The tentative dates of the term tests are:

- Test 1 will be on Feb 4, 2024
Test 2 will be on March 11, 2024

Final Assessment

The final assessment will be held during the final assessment period in April 2025 and will be scheduled by the registrar. Information about the format will be provided during the semester.

III. Course Policies

Policy on Missed Term Work

Students who are absent from class for prolonged periods and who require consideration for missed academic work should contact the instructor and verify their absence(s) through either the *Absence Declaration tool*, *Verification of Illness or Injury (VOI) form*, *College Registrar Letter*, or *Letter of Academic Accommodation from Accessibility Services*, as appropriate to their situation.
<https://www.artsci.utoronto.ca/current/academics/student-absences>

The absence declaration can be used once per term. Outside of the one time absence declaration use, students must adhere to the alternate processes for absences listed above, as well as the missed work policy as set out in each course's syllabus.

If you miss a term test, then your term test grade will be reweighted to the final; see the grading scheme. Missed quizzes are accommodated by the lowest grade being dropped. If you miss more than one quiz, then you must inform your course Instructor within 72 hours of the test. No exceptions. If your request is approved, you may receive an accommodation. The accommodation to be used will be decided by your instructor. Some examples of accommodations may include: an oral exam, written make-up test, or a re-weighting of your assessments.

Re-marking Policy

A student who believes an individual item of work has been incorrectly or unfairly marked may ask the person who marked it for a re-evaluation. With evidence to back their appeal, students should make such requests as soon as reasonably possible after receiving the work back, but no later than 2 weeks after it was returned. Instructions for regrade requests will be announced on Quercus.

Plagiarism Detection Tool

A plagiarism detection tool may be used for detecting plagiarism in some of the written work submitted in this course. Normally, students will be required to submit their written work to the university's plagiarism detection tool for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their work to be included as source documents in the tool's reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of the this tool's service are described on the Centre for Teaching Support and Innovation web site:

<https://teaching.utoronto.ca/resources/plagiarism-detection/>

Email Policy

Should you have a question that is not answered on the course site (please check there first!) please note that all communications with the Course Instructor or TA's must be sent from your official utoronto email address, with the course number included in the subject line. If these instructions are not followed, your email may not be responded to. Please write in a professional manner.

Land Acknowledgement

We wish to acknowledge this land on which the University of Toronto operates. For thousands of years it has been the traditional land of the Huron-Wendat, the Seneca, and the Mississaugas of the Credit. Today, this meeting place is still the home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land.

IV. Institutional Policies and Support

Academic Integrity

All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters

(<https://governingcouncil.utoronto.ca/secretariat/policies/codebehaviour-academic-matters-july-1-2019>).

If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, please reach out to your Course Instructor. Note that you are expected to seek out additional information on academic integrity from me or from other institutional resources (for example, the University of Toronto website on Academic Integrity <http://academicintegrity.utoronto.ca/>).
(*Academic Handbook Section 12 Academic Integrity*)

Recording of Online Course Materials

This course, including your participation, may be recorded on video and will be available to students in the course for viewing remotely and after each session.

Course videos and materials belong to your instructor, the University, and/or other source depending on the specific facts of each situation and are protected by copyright. In this course, you are permitted to download session videos and materials for your own academic use, but you should not copy, share, or use them for any other purpose without the explicit permission of the instructor.

For questions about recording and use of videos in which you appear please contact your instructor.

Accessibility

The University provides academic accommodations for students with disabilities in accordance with the terms of the Ontario Human Rights Code. This occurs through a collaborative process that acknowledges a collective obligation to develop an accessible learning environment that both meets the needs of students and preserves the essential academic requirements of the University's courses and programs.

Students with diverse learning styles and needs are welcome in this course. If you have a disability that may require accommodations, please feel free to approach your Course Instructor and/or the Accessibility Services office as soon as possible. The sooner you let us know your needs the quicker we can assist you in achieving your learning goals in this course.

Link to Accessibility Services website: <https://studentlife.utoronto.ca/departments/accessibility-services/>

Equity, Diversity and Inclusion

The University of Toronto is committed to equity, human rights and respect for diversity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect where all members of our community can express themselves, engage with each other, and respect one another's differences. U of T does not condone discrimination or harassment against any persons or communities.

Important Academic Dates & Deadlines

The academic dates include enrolment dates, drop deadlines, exam periods, petition deadlines and more.
<https://www.artsci.utoronto.ca/current/dates-deadlines/academic-dates>

Other Academic and Personal Supports

- Writing Centre <https://writing.utoronto.ca/writing-centres/arts-and-science/>
- U of T Libraries <https://oneresearch.library.utoronto.ca/>

- Student Code of Conduct: <https://governingcouncil.utoronto.ca/secretariat/policies/code-studentconduct-december-13-2019>
- Feeling Distressed? <https://studentlife.utoronto.ca/task/support-when-you-feel-distressed/>
- Academic Success Centre <https://studentlife.utoronto.ca/departement/academic-success/>
- College/Faculty Registrars <https://future.utoronto.ca/current-students/registrars/>

V. Schedule of Lectures

Below is a rough schedule of lecture content throughout the semester. This is subject to change as there will be natural variation between lecture sections due to pacing, questions, etc.

Week	Material	Textbook references
1	Basic operations on \mathbb{C} , polar coordinates, roots of unity	[F1.1-1.2]
2	Sets in \mathbb{C} and their topology (open, closed, connected, boundaries). Functions, limits, convergence of sequences and series. Examples of complex functions. Tutorials begin	[F1.3-1.5] [AF2.2]
3	Curves, Jordan curve theorem. Line integrals and Green's theorem. Quiz 1	[F1.6], [AF 2.4]
4	Analytic functions and Cauchy-Riemann equations. Harmonic conjugates. Cauchy's theorem and Cauchy's integral formula.	[F2.1] [F2.3], [AF 2.5-2.6]
5	Term test 1. Cauchy's integral formula and consequences	[AF2.6]
6	Series of functions and power series. Laurent series. Quiz 2	[AF3.1-3.3]
7	Singularities of functions. Residue theorem. Quiz 3	[AF3.5] [AF4.1]
8	Applications of residue theorem	[AF4.2-4.4]
9	Term test 2. Residue theorem wrap-ups.	
10	Conformal mappings and applications	[AF 5.1-5.4]
11	Bilinear transformations, Schwarz-Christoffel formula. Laplace and Fourier transforms. Quiz 4	[AF5.6-5.7], [AF 4.5]
12	Asymptotic evaluation of integrals	[AF 6.1-6.4]

[F] = Fisher, [AF] = Ablowitz and Fokas