Mathematics 3770H – Complex Analysis

Trent University, Winter 2022 *[Last modified 2022-01-04.]*

Instructor

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Department of Mathematics

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Prerequisite: MATH 2120H – Calculus IV: Vector Calculus

Text

A First Course in Complex Analysis, by M. Beck, G. Marchesi, D. Pixton, & L. Sabalka
The most current version of this book is available for free at: `http://math.sfsu.edu/beck/complex.html`
(There will also be a local copy on Blackboard.)

Meetings

Lectures: Tuesdays 12:00-12:50 in ENW 110, Wednesdays 15:00-15:50 in DNA B106, and Fridays 08:00-08:50 in DNA B105.
Labs and Seminars: Fridays 09:00-09:50 in DNA B105.

Marking Scheme

There will be at least eleven weekly assignments (due Fridays) and a final examination. These will weigh as follows in the final mark:

`Best 10 assignments (6.5% each)`	`65%`
`Final examination`	`35%`

Please note that work worth at least 25% of the course should be marked and returned by the final date (Friday, 11 March) to withdraw from the course without academic penalty. Students unable to complete quizzes or assignments in time should contact the instructor as soon as possible.

This scheme may be modified for individual students in *exceptional* circumstances. Any such modification will require the agreement of both the student and the instructor.

Content & Learning Outcomes

Crudely, MATH 1120H is an introduction to complex numbers, doing calculus with functions of complex variables, and some applications thereof. Upon successful completion of this course, the student will:

1. be familiar with the algebraic field structure of the complex plane, and be able to solve basic equations using both Cartesian and polar coordinates,
2. be familiar with complex polynomial, rational, exponential, trigonometric, logarithmic and power functions, and the uses of branch cuts when defining the latter two families,
3. be able to compute derivatives of complex valued functions and to use the Cauchy-Riemann equations,
4. be familiar with integration along paths, Cauchys theorem, Cauchys integral formulae,
5. understand that analytic functions can be expressed as power series, and compute Taylor series expansions of analytic functions,
6. be familiar with Laurent series, singularities, poles, and know Cauchys residue theorem,
7. be familiar with the Fundamental Theorem of Algebra,
8. be able to apply their knowledge of integration to sum certain series and evaluate certain real integrals,
9. have some exposure to applications in frequency analysis via various transforms, and
10. develop facility with using software such as `SageMath` to compute solutions to standard problems in basic complex analysis.

Schedule

In terms of content, this schedule should be taken with a grain of salt: no lesson plan survives contact with students unchanged. We will speed up or slow down, and perhaps rearrange some material, depending on how things go. Please note that while we will not fully cover the content of every chapter, we may from time to time cover bits of material that is not in the textbook in class or the assignments. In addition, many assignments may involve using `SageMath` or similar software.

Weeks 1 & 2. *(10-21 January)* Chapters 1 & 2: Algebraic and geometric properties of the complex naumbers, limits, continuity, and differentiability. Assignment # 1 due on Friday, 21 January.
Weeks 3 & 4. *(24 January – 4 February)* Chapters 2 & 3: Holomorphic functions, the Cauchy-Riemann equations, examples of functions. Assignment #2 due on Friday, 28 January, and Assignment #3 due on Friday, 4 February.
Weeks 5 & 6. *(7-18 February)* Chapter 4: MDefinition and basic properties of integration, antiderivatives, Cauchy's Theorem and Integral Formula. Assignment #4 due on Friday, 11 February, and Assignment #5 due on Friday, 18 February.
Reading Week. (21-25 February) Enjoy! *University closed for Family Day on Monday, 21 February.*
Weeks 7 & 8. *(28 February – 11 March)* Chapters 5 & 6: Consequences of Cauchy's Theorem, harmonic functions and the Laplace equation. Assignment #6 due on Friday, 4 March, and Assignment #7 due on Friday, 11 March. *The last date to withdraw from this course is Friday, 11 March.*
Weeks 9 & 10. *(14-25 March)* Chapters 7 & 8: Sequences and series, Power and Taylor series, convergence. Assignment #8 due on Friday, 18 March, and Assignment #9 due on Friday, 25 March.
Weeks 11 & 12. *(28 March – 8 April)* Chapters 8 & 9: The Identity Principle, Laurent series, residues, the Argument Principle. Assignment #10 due on Friday, 1 April, and Assignment #11 due on Friday, 8 April. *Classes end on Friday, 8 April.*
Examination period. *(11-27 April)* The final exam will written at a time and location to be determined. *University closed for Good Friday on Friday, 15 April*

Academic Integrity

> *Academic dishonesty, which includes plagiarism and cheating, is an extremely serious academic offence and carries penalties varying from failure on an assignment to expulsion from the University. Definitions, penalties, and procedures for dealing with plagiarism and cheating are set out in Trent Universitys Academic Integrity Policy. You have a responsibility to educate yourself unfamiliarity with the policy is not an excuse. You are strongly encouraged to visit Trents Academic Integrity website to learn more:* `www.trentu.ca/academicintegrity` .

For clarity, the following guidelines will apply in MATH 3770H:

> You are permitted and encouraged to work with others and ask anyone willing (especially the instructor!) for explanations, hints, and suggestions on the assignments, and to consult whatever sources you wish. However, **all work submitted for credit must be written up entirely by yourself, giving due credit to all relevant sources of help and information. For the final exam, you are permitted to use your textbook and all other course material, but you may not use any other sources or aids, nor give or receive any help**, except to ask the instructor to clarify questions and to use a calculator (any that you like), unless you have the instructor's express permission.

Access to Instruction

> *It is Trent University's intent to create an inclusive learning environment. If a student has a disability and documentation from a regulated health care practitioner and feels that he/she may need accommodations to succeed in a course, the student should contact the Student Accessibility Services Office (SAS) at the respective campus as soon as possible.*

Archive Page

> Course materials will normally be distributed via Blackboard and will also be archived at:
> `http://euclid.trentu.ca/math/sb/3770H/`