Course Outline: AM3811a, 2018/2019
Complex Variables with Applications

Instructor Robert M. Corless
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Middlesex College, Room 272
Office hours Monday 11:30–12:30
Friday 8:30–9:30 AM

Course Meeting Times Monday, Wednesday, and Friday, 9:30–10:20, MC 17.

Textbook (Required) Fundamentals of Complex Analysis by Saff and Snider, 3rd edition (on short–term loan at library; paperback available at bookstore I believe).

> "The payoff is enormous" — p.53

Course Antirequisite Mathematics 3124A/B.

Course Prerequisites Calculus 2303A/B or Calculus 2503A/B.

Unless you have either requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequistes.

Important Note From The Instructor (Rob Corless)

In Fall term 2017, I had accepted three invitations to speak (at two conferences in Australia, and separately I had accepted to speak to the University of Western Michigan mathematics student Honor Society). These commitments required that I had to miss several lectures last year; 9 out of 37, to be precise. To make a virtue out of necessity, I then made this a **blended course**: over July and August last year I made several video lectures and demonstrations, which are available on OWL.

In addition to the videos that I prepared with the help of the Instructional Technology Resource Centre, and with the help of the Teaching Support Centre, I have watched and evaluated the wonderful five–lecture series by Herb Gross (made over 40 years ago, and now distributed freely by the Open Course Ware project of the Massachusetts Institute of Technology), available at `https://goo.gl/T2jcZb`. They are so good that I am requiring that students taking this course watch them. They are surprisingly accessible: one might be afraid that material for a course at MIT would be too advanced, but this is not so. Professor Gross does assume that you remember a little vector calculus, which you would get from Calculus 2303/2503 here, but even that is only in one of his five videos.

I have made several "lightboard" videos, and several "whiteboard" videos. The students in 2017 liked the videos, so I am using them again. I hope you like them too. They have several advantages over in-class lectures.

Indeed, I will cancel four lectures (at least) this year in favour of the videos. In particular, there will be no class September 28 (I will be at OUF), and no class October 5 (the Friday before Reading Week), no class October 15 (the Monday after Reading Week) because I will be in Vancouver, and no class October 19 because I will be in Waterloo.

On email: Owing to a disability, I can only read computer screens for a short time each day. My email is printed for me, once a day Monday to Friday. I will respond in a timely fashion, but do not expect instant answers.

Assessment

Reading/watching memos*	10%	($5 \times 2\%$)
Assignments (five of them)	30%	(5×6 %)
Midterm+ (Friday October 26, 7:00–9:00 PM, Room TBA)	20%	
Final Exam	40%	

*A "reading memo" or "watching memo" is a copy of your *contemporaneous notes* that you make while doing your *assigned reading* or your *assigned watching* of the course videos. I'll read your memos and answer your questions. You get marks just for handing them in.

+I will hand out a practice midterm.

Assignment Due Dates Assignments due in class, *start* of class (9:30 AM).

A1:	Monday	September 17
A2:	Monday	October 1
		(Midterm Friday October 26)
A3:	Monday	November 5
A4:	Monday	November 19
A5:	Monday	December 3

Collaboration Is Permitted On Assignments but you *must* acknowledge in your written work who has helped you, or whom you have helped. Copy/paste is useless and not allowed, of course. You must write it yourself.

Write legibly, and include your full official name. **Buy a stapler if you have to, and staple your assignments**. *No late assignments accepted without prior arrangement.*

Book Sections Covered

- Sections 1.1–1.6 Complex Numbers. See MIT OCW Lecture 1.
- Sections 2.1–2.5 Analytic Functions. See MIT OCW Lecture 2.
- Sections 3.1–3.5 Elementary Functions. See MIT OCW Lecture 3.
- Sections 4.1–4.5 Complex Integration. See MIT OCW lecture 5.
- Sections 5.1–5.8 Series. See MIT OCW Lecture 4.
- Sections 6.1–6.7 Residue Theory.

My own video lectures largely support Chapter 2 and some of Chapter 3, because that's when I was away last year; the midterm will cover chapters 1, 2, and 3.

On Technology

In the classroom Please be mindful of your neighbours. Facebook (for instance) is addictive and very distracting. We will discuss on Day 1 a mutually agreeable protocol, e.g. "back rows only" for computer/phone/tablet use.

On assignments Everything is permitted (except copy and paste)—but cite your sources and software, and acknowledge any help by others.

On exams Closed book, closed notes, no computational assistance, no asking others for help. A formula sheet (no solved problems) will be allowed. I will inspect your formula sheets.

Supplementary Textbook/Readings

- Complex Numbers: A self–study guide: from "Computational Discovery" by Chan and Corless (in progress). Available on OWL.

On short–term loan in the Taylor library:

- R.P Boas. Invitation to Complex Analysis. QA 331.B644. 1987/2010. Very easy to read.
- E.T. Copson. An Introduction to the Theory of Functions of a Complex Variable. 19365/2012. Full text online. A classic; now available free. A tough read, but worth the effort. `https://archive.org/details/TheoryOfTheFunctionsOfAComplexVariable`.
- Peter Henrici. Applied and Computational Complex Analysis, Volume I. QA 331.H463. 1974. My favourite text. I've worn out two copies. Takes a different approach to our text in that it starts from formal power series. Beautifully written. Volume II is also very useful. Volume III is stratospheric.
- E. Wegert. Visual Complex Functions: an Introduction with Phase Portraits. Full text online (through our library). QA331.7W44. A simply beautiful book. Phase Portraits ftw.

Learning Outcomes

By the end of the course the student will be able to

- Perform basic mathematical operations with complex numbers in Cartesian and polar forms.
- Determine continuity/analyticity of a function and compute the derivative of an elementary function.
- Perform calculations using elementary functions of a single complex variable and describe mappings in the complex plane.
- Perform calculations with multi–valued functions and use branches of these functions.
- Evaluate a contour integral using parametrization, the fundamental theorem of calculus, and Cauchy's integral formula.
- Compute the Taylor series of a function and determine its circle or annulus of convergence and give a formula for the remainder on truncation.
- Compute the residue of a function and use the residue theory to evaluate a contour integral or an integral over the real line.
- Explain the concepts above; state and prove theorems and properties involving, or give applications of, the above topics.

Addendum To All Applied Mathematics Course Outlines

Accessibility Statement Please contact the course instructor if you require material in an alternative format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD)at 661-2111 x82147 for any specific questions regarding an accommodation.

If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to your faculty's Dean's Office as soon as possible and contact your instructor immediately. It is the student's responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor has been informed. In the event of a missed final exam, a "Recommendation of Special Examination" form must be obtained from your faculty's Dean's Office immediately. For further information please see: `http://www.uwo.ca/sci/undergraduate/academic_counselling/index.html`.

A student requiring academic accommodation due to illness should use the Student Medical Certificate when visiting an off-campus medical facility or request a Records Release Form (located in the Dean's Office) for visits to Students Health Services. The form can be found here: `https://studentservices.uwo.ca/secure`.

Statement On Academic Offences Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a scholastic offence, at the following web site: `http://uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf`.

Support Services Students who are in emotional/mental distress should refer to Mental Health@Western `http://uwo.ca/health/mental_wellbeing/` for a complete list of options about how to obtain help.

Accommodation For Absences Late assignments will not marked, unless by prior arrangement and mutual agreement. Midterm conflicts should not happen, but if they do the student will have the option of receiving a pro–rated mark equal to the appropriately adjusted equivalent of their final exam mark; this will take into account the class average on each exam as well as the student's final exam mark.

The makeup for missed final exams (owing to illness documented as above) will be tentatively scheduled on Saturday, January 13, 2018.

Detailed Lecture Schedule Plan

This is the plan. We'll try to stick to it. But it may change, especially the second half. We meet Monday, Wednesday and Friday 9:30 AM in MC 17. **Read each section prior to class**.

1	7.9.18	Outline, logistics, expectations
2	10.9.18	Watch MIT OCW Lecture 1. Sections 1.1 and 1.2
3	12.9.18	Section 1.3
4	14.9.18	Section 1.6
5	17.9.18	Section 1.7; A1 due;
6	19.9.18	Video for Section 1.4
7	21.9.18	Video for Section 1.5
8	24.9.18	Video for Section 2.1 $z^2 + 2z$ (see also MIT OCW Lecture 2)
9	26.9.18	Video for Section 2.2 Continuity
10	28.9.18	(Away at OUF) Video for Section 2.3 Analyticity
11	1.10.18	A2 due; Video for Section 2.4 Cauchy–Riemann
12	3.10.18	Video for Section 2.5 Harmonic Functions
13	5.10.18	Video for Section 2.6 Steady–State Temperature (Away in Vancouver)
		Fall Reading Week, October 10–14
14	15.10.18	(still away in Vancouver) MIT OCW Video Lecture 3
15	17.10.18	Section 3.1; A2 due; first lecture after away
16	19.10.18	(Away in Waterloo) Section 3.2
17	22.10.18	Section 3.3 (video available also)
18	24.10.18	Section 3.4
19	26.10.18	Section 3.5; midterm
20	29.10.18	Section 3.6; video
21	31.10.18	Section 4.1; see MIT OCW Lecture 5
22	2.11.18	Section 4.2
23	5.11.18	Section 4.3 ; A3 due
24	7.11.18	Section 4.4
25	9.11.18	Section 4.5
26	12.11.18	Section 4.6
27	14.11.18	Section 5.1; See MIT OCW Lecture 4
28	16.11.18	Section 5.2
29	19.11.18	Section 5.3; A4 due
30	21.11.18	Section 5.5
31	23.11.18	Section 5.5 (it's a tough section)
32	26.11.18	Section 5.8
33	28.11.18	Section 6.1
34	30.11.18	Section 6.2
35	3.12.18	Section 6.5; A5 due
36	5.12.18	Section 6.6
37	7.12.18	Review

Since email and OWL will be clunky, I urge you to use my office hours! This will be a fun course, because the material is beautiful and powerful. But it's not easy. The assignments will do a lot of the actual teaching; your learning happens there.