**MATH 3057** **FUNCTIONS OF A COMPLEX VARIABLE** **FALL 2021**

**Lectures:** Tuesdays and Thursdays 13:05–14:25. The lectures will be delivered online via prerecorded video. Links will be posted on Brightspace according to the above lecture schedule. You will be able to view the videos anytime after the links have been posted. In addition, lecture notes (pdf files) will be posted on Brightspace.

**Tutorial:** Thursdays 17:35–18:25 in Loeb C264 (please, double check the location before going to class, the university warns that the location may still change)

**Instructor:** W. Jaworski, 4205 HP, phone: 520–2600 ext. 2127, e-mail: wjaworsk@math.carleton.ca

**Office hours:** Tuesdays and Thursdays 10:30–11:30 or by appointment; in person and via Zoom. See Brightspace for details.

**Text:** S. D. Fisher, *Complex Variables, 2nd edition.*

**Overview:** Complete understanding of many familiar functions is impossible without considering complex values of the variable. For example, the function $f(x) = (1 + x^2)^{-1}$ is defined for all real values of $x$ and has derivatives of all orders but its Taylor series $(1+x^2)^{-1} = 1-x^2+x^4-\dots$ converges only for $|x| < 1$. This is puzzling when considering only real values of $x$: the real numbers $x = \pm 1$ which separate the domains of convergence and divergence of the series do not appear any different, from the point of view of our function, than any other real number. Permitting $x$ to take complex values puts the situation in a new light: on the circle $|x| = 1$ there are points $x = \pm i = \pm\sqrt{-1}$ at which $f(x)$ becomes infinite; this is why the series ceases to converge when $|x| \geq 1$.

Considering complex values of the variable leads to a deeper understanding of elementary functions and unravelling of many interesting and useful relations among them. Thus, trigonometric functions turn out to be simple combinations of exponential functions, e.g., $\cos x = \frac{1}{2}(e^{ix}+e^{-ix})$, while the inverse trigonometric functions can be expressed in terms of the logarithm, e.g., $\arccos x = -i \log(x+\sqrt{x^2-1})$.

The Fundamental Theorem of Algebra, i.e., the statement that every nonconstant polynomial has a root in the set of complex numbers, is an easy consequence of the theory of functions of a complex variable.

The theory of functions of a complex variable provides us with effective methods of computing integrals and infinite series, and with means of studying solutions of differential equations. Functions of a complex variable describe vector fields on the plane and appear in solutions to many problems in Physics and Engineering. In Mathematics the theory of functions of a complex variable is being used not only in Analysis but also in Algebra, Number Theory, Topology, Geometry, and Probability.

This introductory course will cover most of Chapters 1 and 2 of the text. Time permitting, selected topics from Chapter 3 may be included.

**Prerequisites:** MATH 2000 with a grade of no less than C- , or permission of the School.

| **Grading scheme:** | | |
|---|---|---|
| | Assignments | 30% |
| | Midterm test (80+10 minutes) | 24% |
| | Final examination | 46% |

A term grade of less than 21/54 will result in an automatic failure, regardless of the result of the final examination.

You will have to upload pdf files of your completed assignments, by the due date, into Brightspace. The midterm and the final exam will consist of sets of questions that you will need to solve at home during a specified time slot, scan your solutions, and upload as pdf files into Culearn. Your solutions to the midterm and the exam must be written by hand.

The **midterm test** will be written on **Thursday November 4**, during the lecture time slot. We will start at 13:00 and end at 14:30. This time slot will include the time needed to scan and upload your solutions (and print the questions, if you wish).

**Homework:** Homework will be posted on Brightspace weekly on each Monday, with a skip in the week of the midterm. It will be due on Monday by midnight, 7 days later. Three randomly chosen questions from each assignment will be graded. Tutorials can be used, in part, to clarify the homework questions and get hints. It is recommended that work on homework start well ahead of the tutorial (and the due date).

**Academic accommodation** on account of a disability or for other reasons can be granted only in accordance with the Academic Accommodation Policy. Students with disabilities who require academic accommodation should contact the Paul Menton Centre (PMC), ph. 613-520-6608, pmc@carleton.ca. Please ensure that I receive your Letter of Accommodation no later than two weeks before the first in-class test requiring accommodation. After requesting accommodation from the PMC, contact me to confirm that accommodation arrangements are made. If you require accommodation for the formally scheduled December Final Examination, you must submit your request for accommodation to the PMC **no later than November 12, 2021**. For more information please see https://carleton.ca/pmc/.

**Recording of academic activities and use of course materials:** Please note that unauthorized student recording of classroom or other academic activities (including advising sessions or office hours) is prohibited. Unauthorized recording is unethical and may also be a violation of University policy. Students requesting the use of assistive technology as an accommodation should contact the Paul Menton Centre. Unauthorized use of classroom recordings – including distributing or posting them – is also prohibited. Under the University's Copyright Policy, faculty own the copyright to instructional materials – including those resources created specifically for the purposes of instruction, such as lectures slides, lecture notes, and presentations. Students cannot copy, reproduce, display, or distribute these materials or otherwise circulate these materials without the instructor's written permission. Students who engage in unauthorized recording, unauthorized use of a recording, or unauthorized distribution of instructional materials will be referred to the appropriate University office for follow-up.

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