Calculus is a powerful mathematical tool which has proven to be of profound practical use in the sciences and one of the great achievements of human thought.

But you know that already.

The theory of calculus with complex numbers, also known as the theory of functions of a complex variable, is significantly richer than just the extension of calculus to the real plane. The beautiful underlying algebraic and geometric structure of the complex numbers allows us to describe a large class of extremely well-behaved and physically-relevant functions with a very small number of conditions and allows us to better understand functions of a real variable. It’s an exciting twist on a well-known story, and will quite possibly answer many questions you never knew you had.

This course is an introduction to complex analysis, intended primarily for engineering students. Some attention will be paid to theory but mainly this course will be focused on developing your ability to work in the realm of calculus with complex numbers.


Course Materials: You will be able to find a syllabus, course outline, homework assignments, announcements and so forth on my course webpage listed above. You should check the website regularly for updates and changes. You should be able to keep track of your grades on Moodle.

Grading: Grading Your final grade will be the higher of the two percentage combos:

i) Homework: 20%, Midterm Exam: 40%, Final Exam: 40%

ii) Homework: 20%, Midterm Exam: 20%, Final Exam: 60%

There will also be a bonus due to course participation. See the Course Participation section for how that works.
**Tutorial:** There is a weekly tutorial section that I strongly encourage everyone to attend. It is an hour long and will mainly be devoted to demonstrating somewhat more challenging problems using the techniques given in lecture. A major component of this will involve dividing the room into groups and having them work on problems in a supervised way. See the next section for more details on course participation. If you have a conflict that prevents you from attending tutorial regularly, you should let me know about it. Bring paper because you may be asked to hand in your scrap work to indicate your attendance.

**Course Participation:** You will get a small bonus for participating in the course, mostly for participating in tutorial, up to a possible five points total added to your final grade. You get these in the following ways:

i) Read this entire syllabus carefully then go to the form at [http://tinyurl.com/mthe228](http://tinyurl.com/mthe228). Tell the survey that you have read the syllabus carefully and that you take responsibility for understanding its content. This will earn you one point if you do this before the end of Week One (or as soon as is reasonable if you joined the course late).

ii) Up to four points by participating in tutorial. This will be judged by the TA and based on some of the following criteria: general attendance, participating in group, answering and asking questions, and so forth. Essentially doing things other than just hang out. There are not rigid rules here, nor will you know how many points you have until the course ends, but if you attend most of the tutorials and are generally an active participant these points shouldn’t be too hard to earn, so you don’t have to be overzealous.

If you can’t attend tutorial (with good cause) and would still like a shot at participation credit, let me know as soon as possible and we’ll figure out another arrangement.

**Homework:** There will be eleven homework assignments and uncollected practice problems from the textbook. Homework will be assigned every week on the course website and will be collected on Wednesday (unless otherwise stated) by the end of class. If you expect that you will be absent from class, you must either get a hard copy of the assignment to me (my office is Jeff 512, there’s a mail slot there) before class or have a friend hand it in for you. As a general rule, no late homework will be accepted. As a release-valve for unexpected disaster striking (e.g. illness, family emergency, just a really busy week) the lowest two homework grades will be dropped. You are still responsible for all of the material covered in all of the homework assignments, even if you don’t hand them in.

Now, when I say “as a general rule” your first question might be “so what are the exceptions?” For this I refer you to the section on General Difficulties.

None of you are new to math, so it probably goes without saying that homework problems will often be harder than the examples given in lecture, this is because much of the purpose of homework is to practice using more basic techniques to break down larger, multifaceted problems. Note that you are not done with a problem just because you got the right answer, but when you understand why the methods you used had to have worked. The problems should make sense to you. **Show your work.** Give clear and detailed answers. Remember, the homework you hand in is worth 20% of your grade, but the homework you understand is worth the other 80%.
**Academic Integrity and Collaboration:** You are expected to abide by all Queen’s University academic integrity standards. Your exams will be closed book and you should prepare for them with that understanding. However, outside of the exams, your peers are a valuable resource, and I encourage you to seek each other out. There is a strong qualitative difference, however, between working together to share ideas (which is good) and copying one another (which is bad). Your solution write-ups should be your own and in your own “words”, and you should be able to do your write-ups independently.

**Technology:** While computers, tablets, phones, etc. are valuable sources of information, there is little cause to use them during lecture. They are permitted if you use them for note-taking, or reading the accompanying lecture notes, but otherwise please refrain from using them for activities unrelated to the class.

As for calculators, only Queen’s-approved models are permitted for the exams. I do not intend for them to be necessary, but you may prefer to have them on-hand. Some homework problems may require the use of a computational device (like a calculator or Google) and will specifically ask you to. Otherwise I don’t want part of your solution to say that you got your solution from Wolfram Alpha (you need to show your work) though I don’t mind if you check your answers.

**Submitting Homework:** The following rules will be strictly enforced:
1. Write your name clearly at the top of every page.
2. Number your pages.
3. Clearly number each problem. If a solution spans multiple pages, indicate the problem number on each page as well as the page number.
4. **Staple** your homework. Paperclips and folded corners are accursed and unacceptable.
5. Turn in assignments on time. It is acceptable to have a friend hand in your homework or put it in the mail slot of my office (Jeff 512) before class.
6. Write neatly. If your homework is too messy to read, it will not be graded.

Usually requests for homework extensions will be denied. See the section on General Difficulties if you think your circumstances are different.

**Exams:** There will be one two-hour midterm likely on week 7 or 8, location and time TBD. There will also be a final exam, with the time and schedule TBD sometime during the final exam period. Exams are closed-book and without notes. Unexpected absences will not be permitted except for a severe medical problem or dire emergency. A written note from an appropriate authority (doctor, dean, etc.) is required. If you expect to be absent on an exam day, you need to contact me to make arrangements well in advance (usually more than a week).

Exam problems will be modeled after homework problems, so the best way to prepare is to do and review your homework. Once again, and I cannot emphasize this enough, **show your work.** Especially in test environments. Full credit is given to people who give complete answers and partial credit is given to people who can make significant progress toward a problem.

**Questions:** Mathematical questions are encouraged at any time during the class. Don’t be afraid to ask them. I am also available for general and specific questions via e-mail and during office hours.
Office Hours and Appointments: For those of you unfamiliar with the concept, my office hours are times where you can drop by without an appointment and ask me questions about the material, homework, etc. I run my office hours like a help center: people sit around a room and I make my rounds helping students with problems before moving on to someone else. Office hours are also a good time for you to seek each other out. The best way to learn math is to teach math, and by helping others understand difficult concepts you’ll find that you’ll solidify the ideas in your own minds.

If you are having a difficult time with the material, I really recommend taking advantage of office hours. I am also available by appointment, and if you want to meet with me outside of my office hours, e-mail me your schedule and we’ll set up a time.

Learning Differences and Disabilities: If you have a documented learning difference that needs to be accommodated, regarding the exams or otherwise, you should let me know about it as early as possible and provide a note from the requisite authorities on the matter. Furthermore, Queen’s is committed to providing support for students with physical impairments, and other disabilities. If you think you may need accommodations due to one of these conditions but lack documentation, contact [Queen’s University Disability Services] for more information.

How To Succeed: If you aren’t able to attend class regularly and fail to do the homework, you’ll probably fall behind. Material in this class is cumulative, it builds on itself, and if you miss something without making an effort to catch up, odds are good that it will haunt you until final exam day. You should come to every class. If you’re having difficulty, please let me know. Ask questions in class, attend my office hours, seek each other out outside of class.

Math Help Center: There’s a Math Help Center in Jeffery 201, open from 9:30am to 6:30pm. The tutors there can help answer your questions, although you might have to look at the chart to make sure there is someone on duty who understands complex analysis. It may also be a good place for you to seek each other out.

Outline: The following is a general outline for the material covered throughout the course and is subject to mild variation.

Chapter 1: Complex Numbers
- Basic properties, powers and roots

Chapter 2: Analytic Functions
- Functions of a complex variable, derivatives, Cauchy-Riemann equations, harmonic functions

Chapter 3: Elementary Functions
- Rational, exponential, trigonometric, and logarithmic functions

Chapter 4: Complex Integration
- Contour integration, Cauchy’s integral theorem, Morera’s theorem, Cauchy’s integral formula and applications

Chapter 5: Series Representations for Analytic Functions
- Power series, Taylor series, Laurent series, zeros and singularities

Chapter 6: Residue Theory
- Residue theorem and applications

Chapter 8: The Transforms of Applied Mathematics
- Fourier and Laplace transforms
**General Difficulties:** Unfortunately, sometimes bad things happen, or you just find yourself struggling with the material. If you believe something is seriously affecting your course performance, or will, *contact me as soon as you can* and we can discuss how to get you back on track or how I can otherwise accommodate you. My highest goal for you is that you learn the material, and your grade will be a reflection of that. If by Week Twelve you tell me that some personal tragedy really severely affected your performance for the entire course, I might be sympathetic but by then it will probably be too late to change anything. Please ask for help early so that I have time to find a way to help.

Help may take the form of extensions of homework assignments, grade reweighting, private tutorials, etc. However, these will be arranged as a coherent plan whose aim is for you to learn this material and will likely result from a scheduled meeting.

So, for example, if a particular stretch of bad luck or scheduling prevents you from handing in an assignment, I’ll probably say “Sorry, that’s one of your dropped assignments, do you need help learning that material?” However, if you think it’s possible you’re going to miss more than two assignments or that your performance is just generally suffering, then you should let me know and we can come up with a way to make things better. I want everyone to succeed in this class and I want everyone to be comfortable asking for help if they need it.

**The Letter Zed:** I am from the United States, and so sometimes I talk funny. Please excuse me. Alas, the standard variable in complex analysis is the letter $z$ which, since I am a US Citizen, I am predisposed to pronouncing “zee”. When I taught Math 326 last year I became modestly competent at saying “zed” but since then I’ve become quite muddled and find that I alternate between the two pronunciations arbitrarily. I will make a concerted effort to respect that I am north of the mighty St. Lawrence River and try to say “zed” consistently. I will fail. You may freely correct me until I ask you to stop.

If there any other questions about the course, please feel free to contact me via the e-mail address given at the top of this document. I look forward to seeing you all in lecture.

Cheers, Tom