MAT 303: Calculus IV

Summer II, 2022

Instructor:	Astra Kolomatskaia *(she/her)*	**Time:**	MWTh 6:00 - 9:00 pm
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Website:	http://www.math.stonybrook.edu/~tkolomat/mat303-sum22/		

Course Overview: Last summer, when teaching an offering of *Calculus B*, my syllabus read:

> The reason that calculus is so widely covered in high schools and so widely take by first year students of such diverse academic backgrounds is that a calculus course is amenable to being about the development of a general calculus-independent skill set. Thus, while this course "*primarily concerns integral calculus*", its coverage includes in equal part all associated skills in: algebraic manipulation, the process of translating word problems to pictures and formulas, and critical thinking. In short, a calculus course is a mathematics gauntlet, so welcome to *Maths Gauntlet B*.

My approach to this course will be much the same, and moreover, of all the courses in the calculus sequence, this is the course most similar in flavour to whichever prior course you took that focused primarily on integration. The way that I taught that course was to primarily focus on the integration techniques and to build up to complex multi-step problems that required unleashing your full arsenal of tricks. In the end, of course, learning how to integrate was never the main point.

In this course, we will focus on techniques for solving *Ordinary Differential Equations*. To give an example, the general solution to the equation $y' = f(x)$ is $y = \int f(x)\,dx + C$, so solving this class of problems exactly corresponds to integrating. On the other hand, we will consider problems like $y'' + 2y' + y = e^x$ (this is an inhomogeneous second-order constant coefficient differential equation). So, in general, you can think of everything that we'll be doing as a more general class of problems than integration. In the course of solving these problems, we'll use neat things such as complex numbers, matrices, and eigenvalues. However, we won't assume that you've taken courses like complex analysis or linear algebra; rather, all of these are tools that you'll have to get used to and add to your toolbox.

General Policies: This class is about honing your skills at getting your brain to absorb a wide range of tricks and then being able to deftly pull them off in sequence as to solve complex problems. I am going to teach this course in a way that any attempt to approach the material differently will be unsuccessful and result in you not having a good time with this course. The most common innocent mistake that you might make is to approach this from a perspective of naïve memorisation; this won't suffice as you'll need to practice solving new problems that might combine previously learned techniques in novel ways. On the other hand, the most common malicious mistake that you might make is copying answers from the internet; I will be choosing my problems and presenting my material in a way that will make this easily detectable, and, moreover, there are currently only a handful of students in the course, so I'll have time to look at your work carefully.

Assignments: There will be five weekly assignments. Relative to the norm, I am going to assign fewer problems, but they will be more complex, and I will aim for each problem to have some element to novelty to it. Writing mathematics is akin to writing an analytical essay in English; each solution should clearly communicate a complete logical progression conforming to the language of mathematics. I will maintain a very high standard for the quality of your written solutions.

Presentation: The only acceptable way to submit work in this course is as a **single pdf**. This is either to be typeset, or consist of *scans* of written work. Scans are essentially something that looks like they're produced by a scanner, and, most of the time, are taken by post-processing photos.

Exams: The midterm will be a 24 h long take home exam, and the final will be an oral exam. The way that the final will work is that I will give you all of the problems a day in advance, and ask you to submit written solutions prior to your 25 min time slot. I will spend several minutes looking over your solutions and ask questions that make it very clear to me how well you understand the material.

The main point of having an oral final exam is that it is the single most BS-proof method of determining if you understand something. Note, however, that by giving you the problems ahead of time, and by having a long take-home midterm, I won't actually ever be testing for raw speed.

Grading System: At the end of the semester, I am going to spend several hours carefully considering everybody's work and will then produce a ranking of everybody in the class. In the process of doing so, there usually emerge pretty clear grade boundaries.

Expectations: All of the above probably sounds very uptight and serious. My primary goal, though, is to get you to engage seriously with the course, and to hold yourselves to a high standard. It is my experience that being held to a high standard generally feels much better than being held to a low one.

As an example, if I were to accept low quality solutions that merely had the correct final answer following unclear work, then how grading wold work is that every problem that you did not solve would be points permanently lost from your grade, so if you happened to mess up on two assignments, or have a bad time with a timed 2 h exam, then you would be permanently locked out of an `A`. Similarly, if you failed to learn even 10% of the content of this course, that would also lock you out of an `A`.

On the other hand, my grading system allows for you to demonstrate to me that you've actually developed the problem solving skills that I aim to foster. So, if you're good at solving problems by the end of the course, then I'll have no issue giving you an `A`, even if you completely missed some prior component of the course. For that matter, I won't necessarily require you to have mastered every single technique. For example, if you only learn 80% of the material in this class, but learn it deeply and well, then it will be clear to me that you've learned something substantial, and that would make me happy to give you an `A`.

Prerequisites: Content wise, this course is a direct continuation of a course that teaches the full range of standard integration techniques, so exposure to that is absolutely essential.

Resources: I will post everything that I write in lectures to the course website. I will also post full typeset solutions to the assignments and midterm. I won't be directly following an external resource, but you are welcome to ask me for suggested reading.

Office Hours: Office hours will be by appointment. Just send me an email and we'll arrange a mutually convenient time! Please do take advantage of the essentially unlimited amount of office hours that I'm offering in this model.

University-wide policies:

Student Accessibility Support Center Statement: If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact the Student Accessibility Support Center, 128 ECC Building, (631) 632-6748, or at `sasc@stonybrook.edu`. They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.

Academic Integrity Statement: Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to

follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty please refer to the academic judiciary website at http://www.stonybrook.edu/commcms/academic_integrity/index.html

Critical Incident Management: Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of University Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures. Further information about most academic matters can be found in the Undergraduate Bulletin, the Undergraduate Class Schedule, and the Faculty-Employee Handbook.