

**Math 4023: Introduction to Modern Analysis**  
**Fall 2017**

**Instructor:** Dr. Michael Oehrtman  
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MSCS 426

**Office Hours:** TBA  
and by appointment

**Class Times:** MWF 10:30 pm – 11:20 pm

**Location:** HSCI 303

**Website:** <https://online.okstate.edu> (then log in and find our course)

**Prerequisites:** C or better in MATH 2153 and MATH 3613

**Course Description:** This course develops the content of calculus through rigorous definition and proof. Learning to read and understand rigorous mathematics and to generate proofs requires significant effort that is different in nature from what was required to succeed in most mathematics classes you have previously taken. Consequently, the main activity in this class will focus on students solving challenging problems that are sequenced to develop proficiency in the main concepts and mathematical practices of basic analysis. Although I will frequently give an orienting min-lecture or summarize work completed by the class, most of our time will be spent with students working in small groups, presenting solutions, or leading discussions. I expect active participation through presenting, explaining, hypothesizing, actively listening to others, critiquing (constructively), arguing (collegially), asking questions, validating others work, etc. While solutions to many of the assigned problems may be found in books or online, the *process* of solving them is far more important than the solution! Consequently, I ask that you not refer to any external resources for the content of this course. I will provide several excellent resources for the content of the course at the end of the semester for your future reference.

The content of the course will be organized into 3 units as follows:

1. **Ordered fields:** We will need a deep understanding of the spaces we are working on in order to rigorously develop the machinery of calculus. Although our primary space of operation will be the real number line, we need to develop a rich understanding of what distinguishes it from other ordered fields. We will explore familiar and exotic examples of ordered fields while gaining a feel for the nature of the real line, honing both intuition and proof skills, and establishing foundational definitions of functions, sequences, and limits.
2. **Completeness:** The property of the real numbers that makes it the natural space for calculus is completeness. Roughly speaking, this property ensures that limits exist under the broad range of conditions that we want to consider. We will explore multiple incarnations of the idea of completeness while developing key results about the nature of the number line, limits of sequences, and continuity of functions.
3. **The Calculus:** With the intuition and tools established in the previous units, we will then be able to define the key concepts of derivatives and integrals. While working with important examples, we will significantly expand on basic understandings of single-variable calculus, prove basic results, and point to directions of further study.

**Class Participation and Presentations:** I expect everyone in the class to contribute constructively to the class and group discussions. This can take several forms from clearly articulating points of confusion to uncovering problems with previous lines of reasoning to providing key ideas and breakthroughs. If your entire group is stuck and/or confused (there is something wrong if this doesn't happen on a regular basis, by the way), you should not give up and wait for me to come around, but you should be resourceful in trying to find new ways to attack the problem or uncovering what is wrong with your previous attempts. You should also look for ways to draw other students into the conversation, since much of what you need to learn is how to listen and evaluate mathematical reasoning. You are not participating fully if you are at either extreme: either never talking or doing all of the talking. Throughout the semester, you should aim to make 5 presentations to the class about key ideas in definitions, proofs, or examples that I identify.

**Reading and Definitions:** Readings and problem sets will be posted on the class website. In order to understand what is being discussed in class you must have read the assigned material and attempted the problems BEFORE coming to class. Reading terse and rigorous mathematical text often requires several passes and an active effort to look up definitions, sketch diagrams, reflect on counterexamples, etc. I view one of the main objectives of this class as helping you to become good at reading and writing rigorous mathematics, but doing so will require time and practice on your part. You should not get discouraged if you experience significant confusion and frustration at times in this process since that is normal, and I will do all I can to help you overcome this. The first and perhaps most important step is for you to learn precise definitions and be able to state them without error and to learn to focus on the definitions of the terms in any statement you are trying to understand, prove, or disprove. Getting a definition "close" (but not exact) or focusing only on intuitive interpretations of terms can lead to completely incorrect reasoning, proofs, and results.

**Homework:** You should allot significant time to spend on the homework for this class well in advance of the due date. Very few students will be able to earn much credit on an assignment worked just a day or two before it is due. You should also seek help in office hours well before the day an assignment is due, since it will take time to solidify and apply the ideas you take away from our discussions. The best way to ensure that you are developing the appropriate insights and on the right track is to talk to other students about the problems. I encourage you to work together, but each student must write up his/her solutions in his/her own words. All assignments and due-dates will be posted on the homework page of the class website, and you are responsible for keeping track of them. If you forget to bring your homework to class, you may submit it up to 24 hours later with a 20% penalty. No homework will be accepted later than this under any circumstances. Type or write all of your work LEGIBLY on 8½"×11" paper with at least ONE-INCH margins on all sides free of writing except your name, date, and assignment number, and STAPLE all pages together. In general, assigned questions will require significant depth in your responses. In order to earn an A or B for the course, I anticipate that most people will need to spend *8 to 9 hours per week* outside of class on homework, reading, and studying. If you are struggling in the class, you should discuss your situation with me immediately and will need to devote more time to studying each week.

**Exams:** I will give two in-class exams, one over each of Units 1 and 2. Before each exam, I will provide an overview of what will be covered.

**Final:** The final exam will be comprehensive, but focus more heavily on Unit 3, and administered at the officially scheduled time, **Wednesday, December 13 from 10:00am - 11:50am**. Requests to take the final examination at a time other than the published time will not be granted except in cases of conflict with the scheduled exam time for another course, having three or more exams scheduled in one day,

personal emergencies, or for reasons of religious practice. In particular, nonrefundable plane tickets, weddings, work schedules, and the like are not acceptable reasons for rescheduling final examinations. Please keep this policy in mind when making end-of-semester plans. You must tell me in writing by Monday, November 27, if you have a university-approved conflict with the final exam time.

**Grades:** Course grades will be determined as follows:

	<u>Points</u>	<u>Grade</u>	<u>Points earned</u>
Homework	300	A	900-1000
Participation & Presentations	300	B	800-899
Unit 1 Exam	100	C	700-799
Unit 2 Exam	100	D	600-699
Final	200	F	0-599
<b>Total Possible</b>	<b>1000</b>		

I reserve the right to use discretion if you are on the borderline between two grades, considering performance on the final exam, improvement or decline during the semester, participation, and my subjective judgment of your effort.

**Academic Honesty:** Don't cheat. Don't copy off of other students, allow other students to copy your work, or present work you find in printed or electronic sources as your own. I encourage you to form study groups. Try the homework yourself, and then get together with a study group to go over questions, and to study for tests. You will learn a great deal from articulating your questions and explaining material to your peers. Discussion of assigned homework is encouraged, but you should be sure you fully understand the material by writing your solutions on your own. In this class, copying on quizzes or exams or allowing someone to copy off of you may result in an F! for the course. Copying or allowing someone to copy your work on homework carries a penalty of up to 10 percentage points off your semester homework grade in the first instance and an F! in the class in a second instance. For questions, contact the Office of Academic Affairs, 101 Whitehurst, (405) 744-5627, <http://academicintegrity.okstate.edu>. I deal with cheating very harshly; don't take any chances.

**What if I need help?** You have lots of resources for this course. Often students find it helpful to talk to each other and work through homework or practice problems together. Above all, see me early if you have questions. Good luck.

**Syllabus Attachment:** Please read the OSU syllabus attachment, linked on the web at <http://academicaffairs.okstate.edu/content/resources-faculty-staff>. This has a lot of important information, including important dates and instructions about disability accommodations. Please contact me privately during the first week of the course if you need accommodations as a result of a disability.