



## Math 421: The Theory of Single Variable Calculus (002) SP23

### General Course Information

#### Generic Math 421 Course Description

Covers material in first and second semester calculus, but it is intended to teach math majors to write and understand proofs in mathematics, in general, and in calculus, in particular.

Prerequisites: MATH 234, graduate/professional standing, or member of the Pre-Masters Mathematics (Visiting International) Program.

Course website: <https://canvas.wisc.edu/courses/344520>

#### Course Designations and Attributes

Breadth – Natural Science

Level – Advanced

L&S Credit – Counts as Liberal Arts and Science credit in L&S

#### Credit Hours

This *3-credit class* meets for *three 50-minute class periods* each week over the spring semester and carries the expectation that students will work on course learning activities (reading, writing, problem sets, studying, etc.) for about *2 hours* out of the classroom *for every class period*. This syllabus includes additional information about meeting times and expectations for student work.

#### Instructor

Dr Thomas Chandler (he/him), [tgchandler@wisc.edu](mailto:tgchandler@wisc.edu), <https://people.math.wisc.edu/~tgchandler/>

Availability: The instructor will be available at the following:

- Office Hours: T 3:00pm – 4:30pm (virtual via Zoom), F 12:45pm – 2:00pm (In person, upper level of Math Learning Centre).
- Extra (in-person or virtual) instructor office hours can be arranged on request. Please contact the instructor via Canvas or email to arrange.
- Contributing to Q&A on Piazza predominantly on Monday and Wednesday evenings.

## Class Instructional Mode, Time, and Location

Class	Date & Time	Location
421-002	MWF 9:55am – 10:45am	Van Vleck B119 (in person)

There will be a total of 41 classes with no classes during spring recess (03/11 – 03/19).

## Other Course Information

### Required Textbook, Software, & Other Course Materials

Campus provides students with [technology guidelines and recommendations](#) for instruction. Students should consult these resources prior to the start of the semester.

**Required Textbook:** This course will follow the fourth edition of *Calculus*, by Michael Spivak.

**Software:** The use of LaTeX will be required to typeset homework in this course. Students are expected to use Overleaf (<https://www.overleaf.com/login>) or some alternative LaTeX editor (instructor's recommendations are available on request). Homework templates and guides will be made available on the Canvas page.

**Other:** Handwritten class notes, as well as homework and midterm solutions, will be posted on Canvas.

### Course Website, Learning Management System & Digital Instructional Tools

- All course material, homework, announcements, and grades will be uploaded onto Canvas (<https://canvas.wisc.edu/courses/344520>)
- All virtual contact (e.g. virtual office hours) shall be via Zoom, with link found on the Canvas website ([https://canvas.wisc.edu/courses/344520/external\\_tools/14065](https://canvas.wisc.edu/courses/344520/external_tools/14065))
- Questions of general interest related to the course should be posted and discussed on the course Piazza site (<https://piazza.com/class/lcpac9wtk90xr>) or brought to the office hours. The course instructor will be regularly contributing to posts on Piazza.
- All other questions/problems should be sent to the instructor directly via Canvas or email.

### Grading

This course will be assessed via weekly problem sheets (cumulative, with the two lowest scores being dropped), weekly reading quizzes (cumulative, with the two lowest scores being dropped), two midterm exams (one in-person and one take-home), and a final exam (in-person). The scales given below may be decreased (but never increased) to allow for grade curving.

**Weighting:** 45% Problem Sheets, 5% Reading Quizzes, 15% Midterm 1, 15% Midterm 2, 20% Final

**Tentative Grading Scales:** 0-59 F, 60-69 D, 70-78 C, 79-81 BC, 82-88 B, 89-91 AB, 92-100 A

### Examination

There will be three exams for this course: two midterms (one in-person and one take-home) and a final exam (in-person). The in-person exams shall be closed book and no communication with anyone (in or out of the class) is allowed during the exams. The take-home midterm will be written in LaTeX and submitted virtually on canvas before the deadline. All the exams are cumulative with no make-up exams.

Further information about each exam will be given closer to the time. By signing up to this course, you are agreeing to take the midterms and final exams at the following (Madison, WI) times:

<b>Exam</b>	<b>Date &amp; Time</b>	<b>Location</b>
Midterm 1 (in person)	01 March 6:00 PM – 7:00 PM	To be announced
Midterm 2 (take home)	14th April 11:59pm ( <i>deadline</i> )	Submitted via Canvas
Final Exam	07 May 2:45pm – 4:45pm	To be announced

Please inform the instructor of any problems sitting these exams as soon as possible.

**Exam Proctoring:** Exam proctoring will be required for this course. Failure to use the proctoring service assigned will result in a zero on the exam. Further details will be given before each exam on canvas and in class.

### **Assessed Homework: Problem Sheets**

A problem sheet will be posted weekly on Canvas; these will be assessed and count towards your final grade (see grading above). The problem sheets shall focus on the content presented in the corresponding week's class. These problem sheets are cumulative, but the two lowest scores will be dropped.

Solutions to the problem sheets should be typed up in LaTeX and submitted on Canvas as a pdf before the posted deadline. Tentatively, the problem sheets shall be due Friday by 11:59pm. *A grace period of 6 hours shall be given for submission, however any late submission during this period (without prior permission) will be docked 10%.* The instructor should be informed of any problems with completing this assessed homework.

### **Assessed Homework: Required Reading**

Each week you will be tasked with reading pages out of the textbook and taking a short, repeatable, Canvas quiz about what you have read. The goal of these assignments is to help familiarize yourself with the definitions and theorems that we'll be working with in class that week. It will also give you an opportunity to ask me questions about the reading. Weekly reading assignments will be due (almost) every Monday by 9:55am, before class. These quizzes are cumulative. The instructor should be informed of any problems with completing this assessed homework.

### **Non-Assessed Homework: Further Work and Practice Exam Questions**

On top of the assessed homework, further work may be posted on Canvas and handed out in class but will not be collected or graded; this will include practice exam questions. This work is intended to help you learn how to read and write mathematical proofs on your own, consolidate your knowledge, and prepare for the exams. Feel free to post any questions about the non-assessed portion of the course on Piazza or bring them to the office hours/classes.

## Course Outline:

Tentative Semester Schedule: Math 421 covers Chapters 1-14 of *Calculus* by Michael Spivak, with an emphasis on learning how to write and understand Mathematical proofs. The course will follow the following tentative Schedule.

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<b>Part 1: Prologue</b>	
Week 1	Course Introduction; Chapter 1: Basic Properties of Numbers.
Week 2	Chapter 2: Number of Various Sorts.

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<b>Part 2: Foundations</b>	
Week 3	Chapter 3: Graphs.
Week 4	Chapter 4: Functions.
Week 5	Chapter 5: Limits.
Week 6	Chapter 6: Continuous Functions; Midterm 1 (in-person, 03/01).
Week 7	Chapter 7: Three Hard Theorems.
<i>Spring Recess</i>	
Week 8	Chapter 8: Least Upper Bounds.
Week 9	Chapter 9: Derivatives.

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<b>Part 3: Derivatives and Integrals</b>	
Week 10	Chapter 10: Differentiation.
Week 11	Chapter 11: Significance of the Derivative; Midterm 2 (take-home, 04/14).
Week 12	Chapter 12: Inverse Functions.
Week 13	Chapter 13: Integrals.
Week 14	Chapter 14: The Fundamental Theorem of Calculus.

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<b>Finals Week</b>	
Final	07 May, 2:45 PM – 4:45 PM, location to be announced.

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Typical Week Schedule: A typical week will follow the following timetable

<b>Monday</b>	<b>Tuesday</b>	<b>Wednesday</b>	<b>Thursday</b>	<b>Friday</b>
Reading Quiz; Class	Office Hours (V)	Class		Class; Worksheets; Office Hours

## Generic Course Learning Outcomes

Students will be able to:

- Understand and use the standard methods and tools of mathematical argument (*e.g.* direct and indirect methods, the construction of examples and counterexamples, induction arguments, first-order logic, set theory, and quantifiers).
- Recall and state the formal definitions of mathematical objects (*e.g.* sets, functions, and graphs) and their properties used in calculus.

- Distinguish if a mathematical construct does or does not have the condition of having a particular property formally (*e.g.* limits, continuity, differentiability, and integrability).
- Recall and state standard calculus theorems (*e.g.* Intermediate Value Theorem, Mean Value Theorems, and Fundamental Theorem of Calculus) and recall arguments for these theorems and the underlying logic of their proofs.
- Verify the premises of standard theorems in calculus in order to apply their conclusions in the context of longer arguments; for example, verifying that a function on a compact set is continuous in order to claim it achieves a maximum value.
- Prove or disprove statements related to the definitions, properties, and theorems of calculus using the techniques of mathematical argument.
- Write mathematical proofs and concepts in logical, reasonable, and concise ways using appropriate mathematical terminology.

## How to Succeed in this Course

The students should strive to attend all classes. The office hours and discussion boards are also highly recommended. The classes are informal instructional lectures ran by the instructor, any interruption for questions or observations are welcomed and recommended — there are no ‘silly’ questions in this course! The class will also often have informal ‘discussion’. During these discussions, we shall work together through group activities to help develop the students understanding of the course content, as well as to hone our proof writing skills; participation in discussions is expected. The office hours are for any questions (either about the course or the bigger picture) but are also a chance to just say ‘hi’ and chat with fellow mathematicians. You do not have to have a specific question to come to the office hours but can instead just come to listen. Finally, any course related questions should be sent to me, the instructor, via email ([tgchandler@wisc.edu](mailto:tgchandler@wisc.edu)) or Canvas (<https://canvas.wisc.edu/courses/344520>).

The following campus services might also be useful:

- [University Health Services](#)
- [Undergraduate Academic Advising and Career Services](#)
- [Office of the Registrar](#)
- [Office of Student Financial Aid](#)
- [Dean of Students Office](#)

## Course Evaluation

Students will be provided with an opportunity to evaluate this course and your learning experience. Student participation is an integral component of this course, and your confidential feedback is important. I strongly encourage you to participate in the course evaluation.

## Privacy of Student Records & the Use of Audio Recorded Lectures Statement

Lecture materials and recordings for this course are protected intellectual property at UW-Madison. Students in this course may use the materials and recordings for their personal use related to participation in this class. Students may also take notes solely for their personal use. If a lecture is not already recorded, you are not authorized to record my lectures without my permission unless you are considered by the university to be a qualified student with a disability requiring accommodation. [Regent Policy Document

4-1] Students may not copy or have lecture materials and recordings outside of class, including posting on internet sites or selling to commercial entities. Students are also prohibited from providing or selling their personal notes to anyone else or being paid for taking notes by any person or commercial firm without the instructor's express written permission. Unauthorized use of these copyrighted lecture materials and recordings constitutes copyright infringement and may be addressed under the university's policies, UWS Chapters 14 and 17, governing student academic and non-academic misconduct.

## **Students' Rules, Rights & Responsibilities**

To see the Undergraduate Guide's Rules, Rights, and Responsibilities information, please refer to <https://guide.wisc.edu/undergraduate/#rulesrightsandresponsibilitiestext>

## **Diversity & Inclusion Statement**

[Diversity](#) is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals. The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world.

## **Academic Integrity Statement**

By virtue of enrollment, each student agrees to uphold the high academic standards of the University of Wisconsin-Madison; academic misconduct is behavior that negatively impacts the integrity of the institution. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these previously listed acts are examples of misconduct which may result in disciplinary action. Examples of disciplinary action include, but is not limited to, failure on the assignment/course, written reprimand, disciplinary probation, suspension, or expulsion.

## **Accommodations for Students with Disabilities Statement**

The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy ([UW-855](#)) require the university to provide reasonable accommodations to students with disabilities to access and participate in its academic programs and educational services. Faculty and students share responsibility in the accommodation process. Students are expected to inform faculty [me] of their need for instructional accommodations during the beginning of the semester, or as soon as possible after being approved for accommodations. Faculty [I], will work either directly with the student [you] or in coordination with the McBurney Center to provide reasonable instructional and course-related accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA. (See: [McBurney Disability Resource Center](#).)

## **Academic Calendar & Religious Observances**

The 2022 academic calendar and religious observances can be found at <https://secfac.wisc.edu/academic-calendar/>. Pursuant to university policy UW-880 (<https://policy.wisc.edu/library/UW-880>), students are required to inform their instructors during the first

two weeks of class about any religious conflicts with quizzes and exams taking place during the semester. Students who will miss quizzes and/or exams during the semester because of religious holidays/observances must email the instructor, Dr Thomas G J Chandler, at [tgchandler@wisc.edu](mailto:tgchandler@wisc.edu) to inform of possible conflicts. He will work with the individual student to find suitable alternatives that adhere to university and departmental guidelines. Note that if a conflict is not raised during the initial two-week period, then we cannot guarantee that suitable accommodations will be provided. Because of this, it is vital that students with religious conflicts contact their instructors in a timely manner during the first two weeks of class.