Syllabus and General Information

MTH 320: Analysis I (sec 2) *(Fall 2020)*
MWF 11:30a-12:20a (see below)

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COVID/Remote-learning Info

Instructional Modality.— Remote, flipped w/ both synchronous and asynchronous activities

Synchronous course activities.— Zoom Meeting ID XXXX, passcode XXXX

Mon/Fri 11:30a-12:20a Small-group work and student presentations, attendance required.
Wed 11:30a-12:20a Office hours*, attendance optional.
**Additional office hours available by appointment.*

Communication/tools.— (see D2L site for links)

D2L site Announcements, links to assignments, submission of written work, grades.
Eli Review Peer review of written work.
Piazza Q+A forum for both peer-to-peer and instructor help.
Email Discouraged; please use Piazza instead.
Zoom Synchronous course activities on MWF.
Microsoft Team One-on-one office hour appointments; final oral exam.

Course Description.— A first introduction to single variable real analysis, this course provides the rigorous underpinnings of differential calculus and sequences/series that students would have first seen in Calculus 1 and 2.

The first part of the course concerns the real number line and its characteristics, emphasizing its *completeness*. Key concepts are the *least upper bound* and *Archimedean* properties of real numbers.

The second part of the course discusses rigorously limits and convergence of sequences. Time will be devoted to the new concepts of *limits superior and inferior*, and of *subsequences*. Some convergence theorems (familiar from Calculus 2) will be proven.

The final part of the course begins with extending the notion of limits and convergence from sequences to real valued functions defined on (subsets of) the real line. The *continuity* and *differentiability* of such functions can then be defined. The rigorous justification of the *Intermediate/Extremal/Mean Value Theorems* (familiar from Calculus 1) will be the highlight.

Course Pre-requisites.— Students are expected to be . . .

. . . familiar with Calculus 1 and 2 (MTH132, MTH133, or their equivalents);
. . . comfortable reading and writing mathematical proofs (MTH299, MTH309 or similar).

Components to Your Grade.— (See §4 and §5 for more details.)

8% Attendance to M/F synchronous meetings
1% (+1% e.c.) In-class presentation
15% Written Work: Peer review participation
67% Written Work: Content and style of submission
9% Oral Exam*
**Students who do not participate in the oral exam cannot earn a final grade higher than 2.5 on the MSU scale.*

Contents

§1 Welcome to MTH 320: Analysis I (sec 2)!

The subject of this course is the properties of the real number line $\mathbb{R}$ and how they pertain to differential calculus and the study of sequences and series. At MSU, the differential calculus was first presented to you in Calculus 1; sequences and series form about one quarter of the Calculus 2 curriculum. In those courses you were asked to accept and memorize certain statements ("Theorems") about the real numbers, and functions and sequences thereof, and asked to apply them to solve problems. In this course our goal is to provide the rigorous underpinnings behind such statements.

Calculus, as originally construed by Newton and Leibniz, was based the idea of *infinitesimals* (Newton called them *fluxions* and Leibniz *differentials*). In the modern calculus classroom, many operations are described also via an appeal to an "intuitive grasp" of how these infinitesimals behave. However, there are reasons to be wary of the use of infinitesimals: the fact that infinitesimals are supposed to square to zero indicate that they are *not* what we would normally call "numbers". And if they are not numbers, is it really kosher for us to pretend they are numbers and perform computations with them?

This worry was alleviated in the 19th and early 20th century by, among others, Cauchy, Bolzano, Weierstrass, and Dedekind, who showed that a rigorous understand of the idea of a *limit* can justify calculus using only real numbers, and previous appeals to the infinitesimals can be regarded as a short-hand for limiting operations that do not in fact require such mysterious quantities. The goal of this class is to present to you this justification.

§1.1 Tentative Schedule of Topics.— The intended topic for each week of the course is listed below in order; new course material will be introduced until Thanksgiving. Only ten weeks are included: this gives us one week of flexibility if we need to devote more time on some topics. If we find we have extra time, convergence theorems for series can be added to the calendar around Week 7 or 8. The two weeks after Thanksgiving will be used to conduct oral exams. Needless to say, the schedule is subject to change.

1. Review of notations. The real numbers $\mathbb{R}$ and its subsets $\mathbb{Q}$ (rational numbers), $\mathbb{Z}$ (integers), and $\mathbb{N}$ (natural numbers). Countability of sets. The Archmidean Property.
2. $\mathbb{Q}$ is holey, $\mathbb{R}$ fills in the holes. Completeness Axiom.
3. Suprema and infima. Approximation of irrational numbers by rational ones.
4. Definition of limits and Cauchy's criterion.
5. Properties of limits. Monotone Convergence Theorem.
6. Subsequences and the Bolzano-Weierstrass Theorem.
7. Limit superior and limit inferior.
8. Limits of functions. Definition of continuity.
9. Intermediate Value Theorem. Extremal Value Theorem.
10. Definition of differentiability. Mean Value Theorem.

§1.2 Skills you will practice.— An important component of this course beyond the mathematics content matter is the development of communication skills. You will practice...

- ... *digesting* mathematical content presented to you both in written and in audio-visual formats.
- ... *presenting* mathematical ideas in front of an audience.
- ... *debating* mathematical statements in a small group setting.
- ... *critiquing* written mathematical arguments.
- ... *composing* mathematical proofs.
- ... *preparing* electronic documents with mathematical content.

Therefore, in additional to watching the lecture videos, you are also asked to...

- ... participate in small-group discussions during the synchronous Monday/Friday classes.
- ... volunteer to present the findings of your small-group discussion, in front of all of the students in the class.
- ... type up all homework assignments.
- ... provide constructive peer review on other students' written work using the Eli Review platform.

To facilitate the final two points, I will provide a basic LaTeX template file you can use for preparing your homework assignments. (If you have taken MTH299 at MSU, you are likely already somewhat familiar with the LaTeX system. You can use this template file on Overleaf or with a TeXdistribution you installed on your computer.) You may choose to use other word pressing systems, provided you can generate the output as a PDF file that meet certain formatting guidelines (see §4).

§2 Course Materials

In addition to the required textbook, we will be using heavy amounts of technology facilitated discussion in this course, and so there will be some required hardware/software to enable your participation.

§2.1 Required textbook.—

Title Elementary Analysis - The Theory of Calculus
Author Kenneth A. Ross
ISBN 978-1-4614-6270-5
Publisher Springer
Date 2013
Edition Second
Comment Available for free electronically through MSU libraries, see this catalogue listing.
Comment The topics of this course are covered in Chapters 1, 2, 3, and 5.

§2.2 Required technology.—

Computer For access of websites, reading of electronic documents, and preparation of written assignments.

Internet Access

Webcam *(Can be via smart phone)* for participation in synchronous class activities on Zoom, and for participation in one-on-one meetings (especially the oral exam).

Zoom We will conduct synchronous class activities on Zoom.

Microsoft Teams One-on-one meetings (including the oral exam) with the instructor will be conducted using Microsoft Teams.

LaTeX software Students are expected to submit written assignments in PDF format with line numbering enabled to facilitate peer review. A LaTeX template file will be provided by the instructor; this file can be used both with a personal installation of a TeX distribution on the student's personal computer, or via the Overleaf cloud service. Overleaf can be used at no cost to the student.

(Students may alternatively compose their written work in another document preparation system such as Microsoft Word. The only hard formatting requirement that must be followed is that the submitted work be (a) typed, with one file per question, (b) in PDF format, and (c) has line numbering.)

Eli Review Web service to facilitate peer review of student work. Students submit their work online and receive that of another student to critique. No cost to MSU students.

For help using Eli Review, visit Eli Reivew's user support page.

D2L Learning management system, where we keep the grade book, post announcements, and where you submit your final write-up for each problem set to be graded.
For help using D2L, visit the MSU D2L help site, or e-mail ITHelp@msu.edu.

Piazza This course has a Piazza forum. To access go to "Communication Tools" in the navigation bar on D2L and select Piazza.
For those of you not familiar with Piazza, it is a collaborative Q+A forum where you can ask questions and receive answers both from other students (collaboratively) and from me. Please direct all questions about course material (both course policy and course content) to Piazza. If necessary you can post questions anonymously and publicly, or privately so only the instructor can see.
For help using Piazza, visit their help site.

§2.3 Other Optional Course Material.— To facilitate group discussion of mathematics in a Zoom break out room, here are some ideas.

- A decidedly low-tech and low cost method is to point a webcam at a writing pad. To hold up your WebCam or smart phone, you can use one of the stands mentioned in this article, or potentially just pile up a stack of books.
- Another method is to get large easel pads which you can draw on using a thick marker, or a medium-sized white board. In this case you do not need a camera stand.
- If you have a touch-screen enabled device, consider using a stylus to write on a drawing app, and share screen via Zoom.
- An alternative to touch-screen enabled device is a pen tablet device such as a Wacom Intuos or a Boogie Board Jot which allows you to capture drawing and writing on your computer screen.

§2.4 Policy on WebCam use.— The use of WebCams to show your face is *not required* for the synchronous online activities. You should turn on your WebCam only if you feel comfortable doing so. For the Monday/Friday small group discussions you may choose to only use your WebCam to facilitate showing your work: it is perfectly acceptable to have your WebCam turned on and pointed at a writing pad or a white board. Alternatively, you may choose not to use your WebCam at all and just use a digital writing implement and share your screen.

The only time the use of WebCam is required is for the **final oral exam**. This is for two purposes: to a lesser degree I use this to verify your identity, since the oral exam is a graded component of this course; to a greater extent I use this so that I can see any non-verbal behavioral signals that may allow me to more effectively guide the discussion.

§3 Learning Objectives

In each of the bulleted items below, the "…" is to be replaced by "You will, at the end of this course, be able to".

§3.1 Content Knowledge Objectives.—

Structure of the real numbers.—

- …*explain* the **completeness axiom** for the real numbers and contrast it to the incompleteness of the rationals.
- …*invoke* the **Archimedean property** suitably for constructing examples.
- …*devise mathematical arguments* that take advantage of the completeness property, specifically the **least upper bound** and **greatest lower bound** property.

Sequences of real numbers.—

- . . . rigorously *define* what it means for a sequence to **converge**.
- . . . *verify* the convergence of an explicit sequence of numbers using **Cauchy's criterion**.
- . . . *articulate* the relation between the **Bolzano-Weierstrass Theorem**, the **Monotone Convergence Theorem**.

Continuity and differentiability of functions.—

- . . . *state* the ϵ-δ **definitions of continuity and differentiability** of functions.
- . . . *apply* the definitions to prove or disprove the continuity/differentiability of explicitly defined functions.
- . . . *determine* whether a given statement abut all continuous/differentiable functions is true or false, and provide a rigorous proof or a counterexample.
- . . . *justify* the necessity of each hypothesis in the statements of the **Intermediate/Extremal/Mean Value theorems** by way of counterexamples.

§3.2 Skills Objectives.—

- . . . correctly *use* mathematical terminology in their appropriate context within a mathematical argument.
- . . . *articulate orally* a mathematical concept or argument.
- . . . *read critically* a piece of mathematical writing and identify gaps and weaknesses in the argument; *fill-in* and *remedy* said gaps and weaknesses.
- . . . *compose* extended arguments with style and organization that does not detract from the presentation of the content.
- . . . *hold a mathematical dialogue* both orally and in writing.
- . . . *prepare* typed electronic documents with mathematical content.

§4 Instructional Components

§4.1 Overview of Asynchronous Components.—

Course videos Pre-recorded course videos will be posted to YouTube, with links posted to D2L. *There will be multiple short videos posted per week.*

Ungraded exercises Attached to each video lecture will be a list of exercises, some of which will have solutions included. While these exercises will not be graded, you are highly encouraged to work on them throughout the week as:

- The synchronous class activity on Monday is mainly the small-group discussion of these exercises.
- The weekly problem sets will include questions very similar to those on the ungraded exercises; working through the ungraded exercises will help you answer the graded problem sets.

Graded problem sets Problem sets will be assigned weekly. Prior to turning in a final copy for grading on D2L, students are expected to participate in anonymous peer review using the *Eli Review* platform.

§4.2 Overview of Synchronous Components.—

Monday Classes run from 9/13 through 11/30, with 12 meetings total. Attendance is required and graded. Except for the final meeting which serve as a type of wrap-up, Monday synchronous sessions will be small group discussion in randomly assigned break-out rooms. You can check your work on the ungraded exercises against those of other students. I will bounce around between the break-out rooms to answer questions.

Wednesday Classes run from 9/2 through 11/25; attendance is optional. Wednesdays will serve as office hour + general course Q+A.

Friday Classes run from 9/4 through 11/20, with 12 meetings total. Attendance is required and graded.

- The first meeting will be a technology intro, for students to get used to the break-out room format, and for them to find a comfortable way of sharing their work (either using share screen or pointing video cam at piece of paper, or the white-board function on Zoom).
- The remaining meetings will each be divided into two portions, the first half being small group activities and the second half being volunteer presentations. (See details below.)

Oral Exam To take place between 12/1 and 12/11; scheduled individually.

§4.3 Ungraded exercises and Monday meetings.— *This course will be run in a flipped format.* Course content will be presented to you in pre-recorded course videos, which you can supplement by consulting the course textbook. Each video will have attached to it ≈5 exercises, with at least one solved completely (to provide a model for your written homework). Prior to attending class on Mondays, you are expected to watch all the videos listed for that week, and work on all the exercises. During the synchronous class time on the Monday meetings, you will be randomly shuffled into break-out rooms of 4–5 students each. Please take this time to discuss your solutions for the exercises, learning from each other. *Please be respectful of other students' time and arrive prepared and on-time.* I will float around the different rooms and will stop by to answer questions briefly.

The instructional goals for the exercises and the Monday meetings are:

- You will consolidate your knowledge of the course competencies through individual work and peer discussion. These competencies will appear on the graded problem sets to be assigned after the conclusion of the Monday synchronous meetings.
- You will use the ungraded exercises as formative assessment of your command of course material.
- You will practice, in a small group setting, discussion and dialogue in a mathematics context. You will practice orally explaining mathematical arguments and concepts, and critiquing those arguments and concepts offered by other students.

While the exercises are not themselves graded, attendance to the Monday meetings counts toward your grade. See §5 for details.

§4.4 Friday meetings.— On Friday meetings you will be randomly assigned into small groups of 4–5 students each.

1. Each group will be assigned one "calculus statement"; the group has 10 minutes to decide whether the statement is true, and
   - if true, provide a proof / example
   - if false, provide a disproof / counterexample
2. At the beginning of the break-out sessions, each group will designate[1] one person to present their result; said person should take notes and make sure to follow the discussion.
3. If the group finishes before the 10 minutes are up, they are free to work on the other statements (that are assigned to other groups).
4. After the 10 minutes are up, students will reconvene in the main Zoom meeting. The designated person from each group will be given 6 minutes to present their results to the other students.

The instructional goals for the Friday sessions are:

- You will develop a robust understanding, through a large collection of examples, of "calculus facts"; in particular you will appreciate the role played by the various hypotheses in theorem

[1] preferably by volunteering, since the participation will be graded

statements of calculus.[2]

- You will practice, in a small group setting, discussion and dialogue in a mathematics context. You will practice orally explaining mathematical arguments and concepts, and critiquing those arguments and concepts offered by other students.
- You will practice presenting mathematics in front of an audience, and responding to questions and requests for clarifications.

Participation in the Friday meetings will contribute to your grade, see §5 for details.

§4.5 Written Work.— The main method of assessing your understanding of course content material is through weekly written assignments. Each written assignment will have **three problems** of differing difficulty[3], on the topics of discussion that week. The problems will be based on items and/or competencies included in the ungraded exercises. You are encouraged to work together with other students, provided you follow the guidelines listed in §7 when preparing your submission.

You will find provided on D2L a LaTeX-template file which you can use with any TeX installation. If you have not installed any TeX distribution on your computer, you may also use the (free) Overleaf service to compile your TeX files online. (Those of you who have taken MTH299 should already be familiar with LaTeX.) You may choose not to use LaTeX for the preparation of your submissions, as long as you type up your responses following the guidelines:

- **Each problem should be its own file**. Therefore there should be 3 files you need to prepare each week.
- The title of each document should clearly indicate the Problem Set number and the Problem number the submission is addressing.
- **Do NOT include your name or identifying info anywhere in the text**. To prevent implicit bias, peer evaluation will be *double blind* and instructor will implement *blind grading*.
- **You must turn on line numbering**. This is for the ease of your peers when they critique your work. (This is automatically handled by the LaTeX template provided.)
- **Mathematical expressions must be typed unambiguously**. If using Word or Google Doc, please make use of the built-in equation editors.

A **list of mathematical statements** will be provided, and updated weekly. This list will include all useful mathematical definitions, theorems, etc. discussed to date. When preparing your solution, you may refer to items in this list by their listed numbers. Any statement *not* included in this list must be separately justified, if you choose to use it in your solution.

You will be assessed on both mathematical correctness and writing style; see §5 for details.

Scaffolding.— For the first 4 problem sets, I will require solutions to any "proof" questions to be written in a step-by-step style, where each step must be individually justified. LaTeX macros to support this proof style will be included in the LaTeX template file. To illustrate this style, I include here a proof that $\sqrt{3}$ is irrational.

1. Assume for contradiction that $\sqrt{3}$ is rational.
2. There exists coprime integers p, q, such that $\sqrt{3} = p/q$.
   Justification: definition x.xx of rational numbers, proposition y.yy of existence of "lowest terms" of rational numbers.[4]

[2] This is included since traditionally a large number of the students in MTH320 aim to enter a career in math instruction. I hope you will learn to see Calculus as a vast interconnected web of ideas logically related to each other, rather than isolated statements that need to be memorized.

[3] Each may have more than one part.

[4] The x.xx and y.yy would be replaced by actual numbers from the provided list of mathematical statements.

3. p and q satisfies $p^2 = 3q^2$.
   Justification: $\sqrt{3} = p/q \implies 3 = p^2/q^2 \implies p^2 = 3q^2$.
4. 3 divides p
   Justification: 3 is a prime number, so we can use theorem z.zz.
5. There exists integer r such that $p = 3r$.
   Justification: Definition of divisibility, and Step 4.
6. r and q satisfies $3r^2 = q^2$.
   Justification: By Step 5, $p^2 = (3r)^2 = 9r^2$. Substituting into Step 3 we can divide both sides by 3.
7. 3 divides q
   Justification: same as that of Step 4.
8. 3 divides $\gcd(p, q)$
   Justification: step 4 and step 7, together with theorem w.ww.
9. We obtained a contradiction.
   Justification: Step 1 assumes $\gcd(p, q) = 1$. Step 8 shows $\gcd(p, q) > 1$.

This style is very verbose, but for the first 4 problem sets I want you to work on making your logic air-tight. For the first four weeks I will also present proofs in the course videos in the same format.

After the first 4 problem sets you can choose whether to continue using this step-by-step style, or to write your proofs in "prose style" (I will also exhibit this style in videos starting week 5.) The prose style of the same proof of irrationality of $\sqrt{3}$ would look something like this:

> Assume for contradiction that $\sqrt{3}$ is rational, and by Definition x.xx and Proposition y.yy, there exist/ coprime integers p, q such that $\sqrt{3} = p/q$. Squaring both sides we find $p^2 = 3q^2$. By Theorem z.zz we find that 3 must divide p, so $p = 3r$ for some integer r. Substituting into the previous expression we get $3r^2 = q^2$, from which we again conclude 3 divides q. But since 3 divides both p and q they cannot be coprime, a contradiction.

Peer evaluation.— We will be using **Eli Review** to perform peer-review of each other's written solutions prior to turning them in for final grading.

Every week you will upload your solutions to the problem sets to Eli Review. For each file/problem that you upload, you will be randomly paired with another classmate[5]. You should provide anonymous *constructive criticism* on the work of your classmate. At the conclusion of the exercise, you are expected to make use of the feedback you received, as well as anything you may have learned from reading the work of your classmates, to improve your write-up prior to turning it in for grading.

To set-up Eli Review, please:

1. Log-in to D2L.
2. Follow the link in *Announcement* box to get to the corresponding D2L page.
3. Follow the on-screen instructions to create an Eli Review account (if you don't have one already); you will be automatically added to the Eli Review course for this class.

Instructional goals for the Peer Review activity are:

- You will critically evaluate written mathematics.
- You will obtain peer feedback on your written work, and will revise your work based on what you learned prior to turning your work in for grading.

[5] In the case where there are an odd number of students submitting that problem, you may occasionally be assigned to a group of three students. You will then be required to provide review for both of your group-mates.

Please be civil to each other when providing feedback. If you feel that another student has been abusive toward your on the platform, please send me an e-mail.

Submission for grading.— Submissions must be typed, in PDF format, and follow the formatting guidelines listed above. Failure to do so will result in a zero on the assignment. To submit your assignment for grading:

1. Go to the course D2L page.
2. Click on "Assignments and Grades" in the Navigation Bar, and select "Assignments".
3. Navigate to the appropriate problem set.
4. You will be asked to upload the files for your assignment. *Make sure to attach all three files.*
    - If you made a mistake, you can re-upload your files as long as it is before the due date.
    - Note: you cannot replace just a single file. D2L will only keep the files uploaded in the most recent submission. If you wish to edit any of the files, you have to re-upload all of them.

The Instructional Goals for the graded assignments are:

- You will receive summative assessment on your learning.
- You will received instructor feedback on your mathematical writing.

§4.6 Oral Exam.— This course will *not* have a written final exam. At the end of the semester each student is required to conduct an oral exam of no more than 40 minutes with me; the exams will be scheduled individually. Procedure and rules:

1. I will have enough openings in my schedule to fit every student; it is however your responsibility to make sure you schedule an appointment in a timely manner to ensure a convenient time-slot for you.
2. Do not be late or miss your appointment. Except in the cases of medical emergencies or loss of internet access, I will not reschedule missed oral exams.
3. Thirty minutes prior to the start of the exam, you will receive by e-mail a short list of questions drawn from in-class exercises and from assigned problem sets (possibly slightly modified).
4. I will ask you to turn on your WebCam so I can see you. Please factor this in when selecting the locale where you will conduct this exam.
5. During the exam you will first be asked to spend no more than 10 minutes presenting the solution to a question of your choice from the list emailed. Then you will be asked to spend 10 minutes presenting the solution to a question of my choice from the list emailed. The exam will grow organically from there, and may touch on problems you may not have previously seen (but within the content-knowledge objectives described in §3.1).

§4.7 Due dates.— All times below are listed in US Eastern time; this is UTC-4 in September and October due to Daylight Saving Time, and UTC-5 in November and December.

In-class Participation Participation grade will be awarded for attendance and engagement on each **Monday** and **Friday** between September 4 and November 30 (24 classes in total).

In-class Presentation Students are required to make at least one in-class presentation on one of the 11 Fridays between September 11 and November 20.

Written Work There will be 11 problem sets, one for each set of videos:

- Problem sets will become available on D2L on **Mondays** at **2pm**. The first on September 14 and the final one on November 23.
- Submission of written work to **Eli Review** in preparation for peer critique are due the following **Wednesday** at **8pm**. *Those who do not submit work on time cannot participate in peer critique, and will earn no points for peer review that week. (For the final assignment, due to*

Wk. n day		Wk. $n-2$ material	Wk. $n-1$ material	Wk n material
Sunday		Complete revision of PS for final submission	Watch videos and do exercises	
Monday	11a	*Final submission of PS due on D2L*		
	class		small group discussion of video content and exercises	
	2p		PS assigned	
	PM			
Tuesday			Work on PS	
Wednesday	AM			
	class		(optional) Q+A	
	8p		*Eli Review submission of PS due*	
Thursday	AM		Eli Review partners assigned	
	PM		Perform peer review	
Friday	class		Small group exercise; student presentations	
	PM		Perform peer review	
	8p		*Peer review due on Eli Review*	
Saturday			Receive review on your PS, revise for final submission	

Table 1: Due dates and what you should be working on during a typical week. At any given time you will be working on course material from two separate "weeks". For the purposes of this chart, weeks start on Sundays. Week 1 in this course is September 6–12. On Week 2, the Week $n-1$ material refers to the video lectures and problem sets associated to Week 1, and there is no Week $n-2$ material due.

Thanksgiving holiday, the peer review will be due on Friday, November 27, at 11am.)

- You will receive your peer critique assignments on Thursday morning. Your reviews will be due on Eli Review on **Friday** at **8pm**. *(For the final assignment, due to Thanksgiving, the peer critique will be due on Sunday, November 29, at 10pm.)*
- You will submit your final copy of written work for grading on the D2L assignments page on the following **Monday** at **11am**. *(For the final assignment, due to Thanksgiving, the final submission will be due on Wednesday, December 2, at noon.)*

Oral Exam The scheduling website for oral exam will open on or around **November 9**. Scheduling is first-come-first-serve, with availability between **December 1—11**. Scheduling website will close on **December 4**, or when all available slots are filled, whichever occurs first.

For a listing of what is due when in a typical week, see Table 1.

§5 Grading Policy

§5.1 In class participation.— Attendance will be taken for each of the Monday and Friday classes between September 4 and November 30 (twenty-four meetings in total). For showing up and participating you earn 1 point. Partial credits may be deducted for tardiness, leaving early, or failure to participate in the small-group discussions (I will bounce around the various breakout rooms to eavesdrop and observe the proceedings).

The lowest four grades are dropped (so you can miss up to 4 synchronous classes).

This portion of your grade is worth 8% of the total course grade.

§5.2 In class presentation.— During each of the Friday classes, after the initial small group discussion, there will be opportunities for 4-5 students to present their groups' work. (Making a total of 44 to 55 chances, as there will be 11 Friday classes between September 11 and November 20.)

You are required to make at least 1 presentation; student who presents in good faith will earn 1% participation credit.

You may make a second and a third presentations; each of them counts toward 0.5% *extra credit* toward your final grade. I however ask that students wishing to take advantage of the extra credit opportunity to give priority to students who haven't yet earned their required presentation credit when your group decides on the volunteer for the presentation.

§5.3 Written Work: Peer Review.— Prior to submitting your responses to the problem sets for grading by your instructor, you are asked to participate in one round of peer review using the Eli Review platform. There will be 11 written assignments total, with 3 problems on each problem set. For each problem you submit on Eli Review, and for each corresponding peer response that you review, you get 1 point[6]. Partial credit maybe deducted for bad-faith submissions (for example, if you submit a blank page, or just the sentence "I don't know how to do this problem") and for bad-faith reviews.

With this you may earn up to 3 points per problem set, or 33 points cumulatively in all. For the purpose of computing your final grade, we will cap the total at **30**. This means that you may miss the peer review for one entire problem set (or one question each on three of the problem sets) and still earn a perfect score on this component.

This portion of your grade is worth 15% of the total course grade.

§5.4 Written Work: Final Submission.— After peer-review you are encouraged to update your responses factoring in the comments of your peers. The updated final copy will be graded both for correctness and style. Each question you turn in will be graded out of 5 points, making 15 point

[6]On occasion you may be assigned to a group of three students. In that case you may earn an extra 0.5 point for having to do two reviews instead of one.

maximum per problem set. Of the 5 points per question:

Correctness is worth 3 points. You earn 3 points for a flawless argument, 2 points for argument with minor flaw, 1 point for being on the right track but with major flaws, and 0 point for everything else.

Style and Form is worth 2 points. This refers to the general organization of your argument and the fluency of your mathematical writing. You will earn 2 points as long as your writing adequately convey your meaning. You will received deductions if there are organizational or formatting issues that hinders the understanding of your writing.

For the first 4 problem sets, you will receive a 0 on this portion if your submission is *not* in the step-by-step format described earlier.

The problem sets are not all worth the same: to reward you for improving over the semester, the earlier problem sets are worth less than the later ones. The first problem set is worth 3% of your final grade, while the last one is worth 8%. The table below contains the full details.[7]

PS no.	1	2	3	4	5	6	7	8	9	10	11	Total
% of final grade ≈	3%	4%	5%	5%	6%	6%	7%	7%	8%	8%	8%	67%

§5.5 Final Oral Exam.— The oral exam will be graded *generously*. It will count toward 9% of your final grade.

§5.6 Computation of final grade.— Your final grade is computed in accordance to the percentages listed above. If you have participated in the final oral exam, your final numerical grade is converted to grades on the MSU 4.0 scale via the following table.

To earn a …	1.0	1.5	2.0	2.5	3.0	3.5	4.0
You need at least …	54%	60%	65%	70%	76%	83%	90%

If you did *not* participate in the final oral exam, your grade on the MSU scale is capped at 2.5, even if you have otherwise earned more than 70% of the available points.

§6 Expectations of Civility

MSU welcomes a full spectrum of experiences, viewpoints, and intellectual approaches because they enrich the conversation, even as they challenge us to think differently and grow. However, we believe that expressions and actions that demean individuals or groups compromise the environment for intellectual growth and undermine the social fabric on which the community is based.

In this course you will frequently interact with other students to provide mutual critique. By providing feedback on each other's ideas and contributions, we grow together to enhance everyone's learning. The expectation and requirement for you to provide constructive criticism should not be taken as an invitation to belittle other students' intellectual contributions. During the small group discussions and when performing peer review on Eli Review, please keep in mind the following basic rules of engagement.

Make it about the ideas Criticism should be directed at ideas, not the individual.[8]

Be constructive Instead of just pointing out shortcomings, share how you would make it better.

Acknowledge your fellow students When engaging in a discussion, do not talk over or ignore others. Every idea that is shared deserves evaluation and consideration.

[7] The table is not exact: it is rounded to the closest integer value; in particular problem set 3 is in fact worth a little less than problem set 4. The D2L gradebook has the exact values included.

[8] To help enforce this, peer review on Eli Review will be double blind; you will not know who reviewed your work, and you will not know whose work you are reviewing. Please do not take this to imply you may be mean or impolite to others in your reviews; *I still know who you are*.

§7 Course Specific Policy on Academic Integrity

Here are specific policies concerning academic integrity for the graded aspects of this course. Unless otherwise noted in the policy here, the University Policy described in §A applies.

Weekly written assignments You are *allowed* to make use of the following resources, *provided you properly acknowledge their use* as indicated below.

- You may consult other students. No acknowledgement is necessary as students are expected to work together in this class.
- You may incorporate details that you learned from the peer-review process (both suggestions provided to you or content you learned from another student's work during the course of review). No acknowledgement is necessary.
- You may consult other scholarly texts and publications (online or in print). Include in your write up full bibliographic information of the item consulted. *For help on deciding what bibliographic information should be included, and how to format the items, please consult any of the citation guides listed on the MSU Library Website.*
- You may *not* use any non-MSU websites that function as: Q+A, "tutoring", or repository of solution manuals in the preparation of your solutions.

While you may use external resources or consult with other students, you *must* write/type your responses in your own words. Copying-and-pasting is not allowed; students found to have copied work from other sources will be assigned a penalty grade.

Eli Review You *may not* share the work assigned to you for review with any other individual.

Oral Exam The oral exam will run over the course of two weeks. You *may not* discuss with other students the content of your oral exam until December 20, 2020.

§8 Attendance Policy

§8.1 Attendance to Synchronous Elements.— The synchronous elements of this course is delivered every **Monday, Wednesday, Friday** between **September 2** and **November 30, 2020** (except for university holidays) at **11:30am–12:20am**. A list of the important dates can be found in §9. The synchronous elements are delivered through Zoom

- Meeting ID: 974 6039 8195
- Passcode: 943610
- *To call in by phone, dial +1 312 626 6799 and enter the meeting ID and passcode above.*

Attendance is *required* for the **Monday** and **Friday** meetings. A portion of your grade will be determined by attendance and participation in the activities.

Attendance is *not required* for the **Wednesday** meetings, which will be run as general Q+A on course material.

§8.2 Grading: Missed Work, Absences, Extensions.— The grading for the attendance/participation portion of the course is, by design, flexible.

Monday/Friday in-class participation Students may miss up to 4 of the 24 Monday/Friday classes and still receive perfect attendance grade.

Eli Review participation Students may miss, in their entirety, the peer-review portion of the written homework for one of the 11 assignments and still receive perfect participation grade.

This built-in flexibility is intended to account for any emergencies (health, family, or internet connectivity), religious observances, and participation in University sanctioned events. In extraordinary circumstances additional excused absences may be given on a case-by-case basis.

For **written homework assignments**, it is the students' responsibility to be aware of the course

schedule and complete the work in a timely manner. In the case of emergencies or exceptional circumstances, extensions to the due dates may be granted on a case-by-case basis.

§8.3 Oral Exam.— Attendance and participation in the individual oral exam is required. Non-participation will result in final course grade capped at 2.5 on the MSU scale.

§8.4 Internet Connectivity Issues.— Many of the participatory components of this course will be conducted synchronously over the internet through Zoom meetings and Microsoft Team meetings. If you suffer a sudden loss of internet connectivity, you can still join the Zoom meetings via the phone number listed above. If you join a meeting by phone, I may ask you to identify yourself, since Zoom's participant listing will not show your name if you join the meeting by phone.

The grading scheme for in class participation factors in the possibility of emergencies such as loss of internet connection. If internet connectivity is expected to be a persistent or recurring issue for you, please reach out to me at the beginning of term and we can discuss possible arrangements.

If you miss any one-on-one meetings (either office hour appointments or the final oral exam) due to connectivity issues, please contact me as soon as possible so we can reschedule if necessary.

§8.5 Administrative Drop for Non-attendance.— In compliance with federal regulations governing financial aid and veterans education benefits, instructors are required to report students who stop attending or who have never attended class. After the first week of classes, through the middle of the term of instruction, instructors who identify a non-attending student should notify their departmental office. Students may be dropped from a course for non-attendance by a departmental administrative drop after the fourth class period, or the fifth class day of the term of instruction, whichever occurs first. (See §9 for relevant dates.)

§8.6 Religious Observation.— University policy requires

> The faculty and staff should be sensitive to the observance of these holidays so that students who absent themselves from classes on these days are not seriously disadvantaged. It is the responsibility of those students who wish to be absent to make arrangements in advance with their instructors.

With very few exceptions, any impact of religious observances on graded work is already factored into the general grading policy (see §8.2) and no additional accommodations will be made.

§8.7 University Sanctioned Events.— If additional accommodation is needed beyond those provided already in §8.2 for participation in University-sanctioned events, students must contact the instructor in advance of the date of the event and the requested accommodation.

§8.8 Grief Absence.— In the unfortunate case you suffered a familial loss, the University has codified the following procedure for reporting and requesting accommodation. It will be **your responsibility** to

1. notify the Associate Dean of your college of the need for a grief absence in a timely manner, but no later than one week from your initial knowledge of the situation,
2. provide appropriate verification of the grief absence as specified by the Associate Dean, and
3. complete all missed work as determined in consultation with the instructor.

For the initial notification, you may use the Grief Absence Request Form from the MSU registrar's office. It is the *responsibility of the Associate Dean or a designee of your college* to

1. determine with you the expected period of absence — it is expected that some bereavement processes may be more extensive than others depending on individual circumstances,
2. notify the faculty that you will be absent, and

3. receive verification of the authenticity of a grief absence request upon your return.

§9 Important Dates

Sept 2 First day of classes
Sept 4 Technology preview, no student presentations
Sept 7 Labor day, no class
Sept 11 Fourth class period
Sept 28 End of Tuition Refund
Oct 21 Middle of Semester
Nov 9 Begin taking reservations for oral exam slots; first come first serve
Nov 26, 27 Thanksgiving, no class
Nov 30 Last synchronous meeting, wrap-up, no group work
Dec 1–11 Oral exams

§A University Policies on Academic Integrity

§A.1 University Policy.— Article 2.III.B.2 of the *Student Rights and Responsibilities* states: "The student shares with the faculty the responsibility for maintaining the integrity of scholarship, grades, and professional standards." In addition, the Math Department adheres to the policies on academic honesty specified in General Student Regulation 1.0, Protection of Scholarship and Grades; the all-University Policy on Integrity of Scholarship and Grades; and Ordinance 17.00, Examinations.

Therefore, unless authorized by your instructor, you are expected to complete all course assignments, including homework, lab work, quizzes, tests and exams, without assistance from any source. You are expected to develop original work for this course; therefore, you may not submit course work you completed for another course to satisfy the requirements for this course. Also, you are not authorized to use the www.allmsu.com or other "tutoring" Web sites to complete any course work in this course. Students who violate MSU regulations on Protection of Scholarship and Grades will receive a failing grade in the course or on the assignment.

Faculty are required to report all instances in which a penalty grade is given for academic dishonesty. Students reported for academic dishonesty are required to take an online course about the integrity of scholarship and grades. A hold will be placed on the student's account until such time as the student completes the course. This course is overseen by the Associate Provost for Undergraduate Education.

§A.2 Spartan Honor Pledge.— Student leaders have recognized the challenging task of discouraging plagiarism from the academic community. The Associated Students of Michigan State University

(ASMSU) introduced the Spartan Code of Honor academic pledge, focused on valuing academic integrity and honest work ethics at Michigan State University. The pledge reads as follows:

> *As a Spartan, I will strive to uphold values of the highest ethical standard. I will practice honesty in my work, foster honesty in my peers, and take pride in knowing that honor is worth more than grades. I will carry these values beyond my time as a student at Michigan State University, continuing the endeavor to build personal integrity in all that I do.*

§B Accessibility

§B.1 RCPD Statement.— Michigan State University is committed to providing equal opportunity for participation in all programs, services and activities. Requests for accommodations by persons with disabilities may be made by contacting the Resource Center for Persons with Disabilities at 517-884-RCPD or on the web at `https://rcpd.msu.edu`. Once your eligibility for an accommodation has been determined, you will be issued a verified individual services accommodation ("VISA") form. Please present this form to me at the start of the term and/or two weeks prior to the accommodation date (test, project, etc). Requests received after this date will be honored whenever possible.

§B.2 Accessibility of course material.— Most of the asynchronous components of the course will be conducted through reading and writing using various technology platforms. Thus of particular concern are support for low-vision users.

D2L has robust support for screen readers. See D2L documentation.

Eli Review conforms with Section 508 standards, and strives to ensure accessibility for low-vision users and those using screen-readers. See `https://elireview.com/support/tech/`.

Unfortunately, displayed equations in PDF documents are known to be problematic for screen readers. Please reach out to me if you need accommodation in this regard.

Student works are expected to be prepared using the LaTeX document preparation system. Some resources for low-vision users can be found on the Blind Science website.

This course also has pre-recorded course videos posted on YouTube. The videos will include captions prepared by the instructor (*not* using automatic transcription).

This course also involves group work and face-to-face discussion using various video conferencing software. Please let me know as soon as possible if this creates a barrier for you and we can try to work toward a solution with RCPD.

§C Limits to Confidentiality

Essays, journals, and other materials submitted for this class are generally considered confidential pursuant to the University's student record policies. However, students should be aware that University employees, including instructors, may not be able to maintain confidentiality when it conflicts with their responsibility to report certain issues to protect the health and safety of MSU community members and others. As the instructor, I must report the following information to other University offices (including the Department of Police and Public Safety) if you share it with me:

- Suspected child abuse/neglect, even if this maltreatment happened when you were a child;
- Allegations of sexual assault, relationship violence, stalking, or sexual harassment; and
- Credible threats of harm to oneself or to others.

These reports may trigger contact from a campus official who will want to talk with you about the incident that you have shared. In almost all cases, it will be your decision whether you wish to speak with that individual. If you would like to talk about these events in a more confidential setting, you are encouraged to make an appointment with the MSU Counseling and Psychiatric Services.