

MATH 150 - Discrete Mathematics

Spring 2023

Course Information and Policies

Instructors

Jonathan Pakianathan

E-mail: jonpak@math.rochester.edu

Lectures: MW 10:25-11:40am in Harkness 115

Office: Hylan 809

Office Hours: (In person or on Zoom 585 275 2216), Wed 11:50am-12:50pm, Thu 11:00am-12:00pm

Sergio Chaves

E-mail: schavesr@math.rochester.edu

Lectures: TR 9:40-10:55am in Dewey 2162. Lectures will be also live streamed over Zoom (won't be recorded)

Office: Hylan 1001

Office Hours: In person: Tue 11:30am - 12:30pm. On Zoom: Wed 4:00pm-5:00pm.

Zoom links can be found in blackboard (there are two different meetings for the lecture and office hours).

Graders

Jianhao Gao

Email: jgao26@u.rochester.edu

Office Hour: Friday 1:30-2:00PM in Wegman 1219.

Runzhou Liu

Email: rliu30@u.rochester.edu

Office Hour: Monday 5PM-5:30PM in Gleason Studio 1.

Yifei Liu

Email: yliu254@u.rochester.edu

Office Hour: Thursday 11:30AM-noon in Gleason Studio 2.

Zirui Li

Email: zli133@u.rochester.edu

Office Hour: Tuesday 3:45-4:15 PM on Zoom 428 569 5266.

Textbook

Discrete Mathematics and its Applications (8th edition) by Kenneth H. Rosen (Note you are welcome to use the 7th edition as well)

Topics Covered

We will cover much of chapters 1-6, 8, 10 of the text. Among the topics we will study are set theory, formal logic, algorithms and their complexity, elementary number theory, induction, counting, recurrence relations, and graph theory. See course schedule details.

Exams and Grading

There will be two midterm exams and a final exam at the following times:

First Midterm

Thursday, Feb 16, 8-9:20AM.

Covers: Sections 1.1-1.8, 2.1-2.3.

* Location: Hoyt Auditorium

* There is an alternate exam for students with conflicts with other common exams. You need instructor pre-approval to take this alternate exam. The alternate exam is on the same day, Thursday, Feb 16 at 9:40-11AM in Hylan 1106A.

* Students with permission from the disability center for alternate testing conditions or extended time must coordinate testing with the disability center who will proctor you directly.

Second Midterm

Tuesday, March 28, 8-9:20AM.

Covers: Sections 3.1-3.3, 4.1-4.6 inclusive.

* Location: Hoyt Auditorium

* There is an alternate exam for students with conflicts with other common exams. You need instructor pre-approval to take this alternate exam. The alternate exam is on the same day, Tuesday, March 28 at 9:40-11AM in Hylan 1106A.

* Students with permission from the disability center for alternate testing conditions or extended time must coordinate testing with the disability center who will proctor you directly.

Final Exam

Monday, May 1, 4-7PM in Hoyt Auditorium.

Part A covers sections covered in Midterms i.e. 1.1-1.8, 2.1-2.3, 3.1-3.3, 4.1-4.6 inclusive.

Part B covers sections 5.1-5.3, 6.1-6.4, 8.1-8.2 and 10.1-10.5 inclusive.

* Location: Hoyt Auditorium

* There is an alternate exam for students with conflicts with other common exams. You need instructor pre-approval to take this alternate exam. The alternate exam is on the next day, Tuesday, May 2 at 9AM-noon in Hylan 1106A.

* Students with permission from the disability center for alternate testing conditions or extended time must coordinate testing with the disability center who will proctor you directly on Monday, May 1.

Your grade for the course will be based on your performance on exams and homework:

* **Homework assignments – 20%**

* **Two Midterm Exams – 20% each**

* **Final Exam – 40%**

The Final Exam will have two parts: Part A will cover the material tested in both Midterms 1 & 2, while Part B will only contain questions related to material appearing after Midterm 2. Part A accounts for 20% of your course grade and Part B accounts for 20% of your course grade. In addition, your score on Part A of the final will replace your lowest midterm score if it is indeed higher than it (it can be used to replace only one midterm score, not both).

NO MAKEUP EXAMS WILL BE GIVEN FOR ANY REASON. If you miss a midterm exam for any reason, then Part A of the final exam will count as your makeup. Final Part A can only replace one midterm score, however.

You will NOT be permitted calculators or other electronic devices (iPhone, smart watches, etc) on any exams. You will NOT be permitted books, notes, or ``cheat sheets'' on any exams.

Incomplete "I" grades are almost never given. The only justification is a documented serious medical problem or a genuine personal/family emergency. Falling behind in this course or problems with workload on other courses are not acceptable reasons.

Attendance

Lecture attendance is not mandatory in MTH150 but is highly suggested.

You are welcome to attend any lecture (see top of webpage for the listing of times and places of the 2 different instructor's lectures). Note that all sections of the course cover the material needed for the exams at about the same pace.

If you do attend a lecture in a section different than the one you are signed up for, please do relinquish your seat to students actually enrolled in that section if the classroom fills - in that case, usually there is room to sit in the aisle or stand at the back of class. This packed classroom situation is generally rare so it should not be a big issue, and hopefully won't occur at all.

Homework

There will be 11 weekly assignments for the semester consisting of a written portion and a WeBWorK portion. Both portions are due on Fridays at 11:59pm. Written homework is submitted through Gradescope. Each assignment will be out of 40 total points; the weighting of WeBWorK vs. written portion will be indicated each week. Your lowest homework score will be dropped. For due dates and times of WeBWork assignments please log-on WeBWorK to see when the set closes. Late assignments are generally not accepted, except in rare cases (such as genuine illness or emergency) supported by documentation.

A “WeBWorK TA” will be available to answer email questions about Webwork homework sets until 7pm on the due date. Questions received after 7pm may not be answered. There is a button on each problem to email the WeBWorK TA. You may access Webwork through the Course Materials menu on your Blackboard page for MTH150.

Written assignments will be posted on the homework schedule (homework) and Gradescope and WeBWork assignments will open at least one week before the due date. You must abide by the Homework Rules (See Below)

Homework Rules

While you are encouraged to work together on both the webwork and written work in the course, it is important that this work be internalized. To facilitate this it is a homework rule that after discussing a written homework problem with friends, TAs or instructors, you should make sure you have internalized it BEFORE writing up your final solution on your own, without reference to the helping source. Under no circumstance should you blindly copy a friend’s solution as your own work. Instead you should absorb the ideas through discussions and then reproduce solutions on your own.

If you worked together with friends X, Y and Z on written work, you should write “worked with X, Y and Z” next to your name on your homework.

Similarly for webwork problems, you should be able to enter the final set of answers on your own and be able to reproduce the solutions to the problem on your own if confronted with the problem again without any solutions.

Workload expectations

This course follows the College credit hour policy for four-credit courses. This course meets 3 academic hours per week. Students may also be expected to deepen their understanding of the course material through close examination/evaluation of the readings assigned in the course.

Help

If you are having difficulty seek help immediately - do not wait until it is too late to recover from falling behind. There are several avenues for you to get help and ask questions, outside of lecture:

- * Attend instructor office hours or schedule an appointment to meet with your instructor.
- * Attend grader office hours.
- * Math study hall is in Hylan 1104 Mon-Thu from 5-8pm. Study Hall schedule (<http://www.sas.rochester.edu/mth/undergraduate/tutoring.html>)
- * Study groups and free tutoring services are often available at The Learning Center (<http://www.rochester.edu/college/cetl/undergraduate/index.html>)
- * There is a “The Learning Center” study group for the course run by Rose Wang on Thursdays, 3:30-4:45PM in Dewey 1-160A.

Disability Support

If you have an academic need related to a disability, arrangements can be made to accommodate most needs. In the event you encounter any barrier(s) to full participation in this course due to the impact of a disability, please contact the Office of Disability Resources. The access coordinators in the Office of Disability Resources can meet with you to discuss the barriers you are experiencing and explain the eligibility process for establishing academic accommodations. You can reach the Office of Disability Resources at: disability@rochester.edu; (585)275-9049; 1-154 Dewey Hall. To be granted alternate testing accommodations, such as extra time, you (the student) must fill out forms with the office of disability resources at least seven days before each and every exam. These forms are not sent automatically. Instructors are not responsible for requesting alternative testing accommodations for you, and they are not obligated to make any accommodations on their own.

Academic Integrity Statement

All assignments and activities associated with this course must be performed in accordance with the University of Rochester’s Academic Honesty Policy. More information is available at: www.rochester.edu/college/honesty (<https://www.rochester.edu/college/honesty/>) .

Math Dept policy on unauthorized online resources: Any usage whatsoever of online solution sets or paid online resources (chegg.com or similar) is considered an academic honesty violation and will be reported to the Board on Academic Honesty. In particular, any assignment found to contain content which originated from such sources is subject to a minimum penalty of zero on the

assignment and a full letter grade reduction at the end of the semester (e.g. a B would be reduced to a C). Depending on the circumstances, this may apply even if the unauthorized content was obtained through indirect means (through a friend for instance) and/or the student is seemingly unaware that the content originated from such sources. If you have any questions about whether resources are acceptable, please check with your instructor.

Class Schedule

CLASSES START: Wednesday, Jan 11

Week of Jan 11

Topics

- 1.1 Propositional Logic**
- 1.2 Applications of Propositional Logic**
- 1.3 Propositional Equivalences**

MARTIN LUTHER KING JR. DAY (no class): Monday, Jan 16

Week of Jan 16:

Topics

- 1.4 Predicates and Quantifiers**
- 1.5 Nested Quantifiers**

Week of Jan 23:

Topics

- 1.6 Rules of Inference**
- 1.7 Introduction to Proofs**

Week of Jan 30:

Topics

- 1.8 Methods of Proof and Strategy**
- 2.1 Sets**

Week of Feb 6:

Topics

- 2.2 Set Operations**
- 2.3 Functions**
- 2.4 Sequences and Summations (skim)**

Week of Feb 13:

Topics

- 3.1 Algorithms**
- 3.2 Growth of Functions**
- 3.3 Complexity of Algorithms**

MIDTERM 1

- Thursday, Feb 16, 8-9:20AM

- Location: Hoyt Auditorium
- Covers sections 1.1-1.8, 2.1-2.3.

Week of Feb 20:

Topics

- 4.1 Divisibility and Modular Arithmetic**
- 4.2 Integer Representation and Algorithms**

Week of Feb 27:

Topics

- 4.3 Primes and Greatest Common Divisors**
- 4.4 Solving Congruences**

SPRING BREAK: Saturday, March 4 to Sunday, March 12.
Classes resume Monday, March 13

Week of March 13:

Topics

- 4.5 Applications of Congruences**
- 4.6 Cryptography**

Week of March 20:

Topics

- 5.1 Mathematical Induction**
- 5.2 Strong Induction**

Week of March 27:

Topics

- 5.3 Recursive Definitions**
- 5.4 Recursive Algorithms (skim)**
- 6.1 Basics of Counting**

MIDTERM 2

- Tuesday, March 28, 8-9:20AM.
- Location: Hoyt Auditorium
- Covers sections 3.1-3.3, 4.1-4.6 inclusive.

Week of April 3:

Topics

- 6.2 Pigeonhole Principle**
- 6.3 Permutations and Combinations**
- 6.4 Binomial Coefficients**

Week of April 10:

Topics

- 8.1 Applications of Recurrence Relations**
- 8.2 Solving Linear Recurrence Relations**

Week of April 17:

Topics

10.1 Graph and Graph Models

10.2 Graph Terminology and Special Types of Graphs

10.3 Representing Graphs and Graph Isomorphism

Week of April 24

Topics

10.4 Connectivity

10.5 Euler and Hamilton paths and circuits

LAST DAY OF CLASSES: Wednesday, April 26

FINAL EXAM:

- Exam time: Monday, May 1, 4-7PM
- Part A covers sections 1.1-1.8, 2.1-2.3, 3.1-3.3, 4.1-4.6, 5.1-5.2 inclusive.
- Part B covers sections 5.3-5.4, 6.1-6.4, 8.1-8.2 and 10.1-10.5 inclusive.
- Location: Hoyt Auditorium
- Alternate Exam: Tue, May 2, 9AM-noon in Hylan 1106A for students with documented conflicts with other common exams.
- Disability center students with adjusted accommodations or extended time should coordinate the exam with the disability center directly who will proctor the exam for them on May 1.

Math 240HW - Introduction to Topology with a Written Component

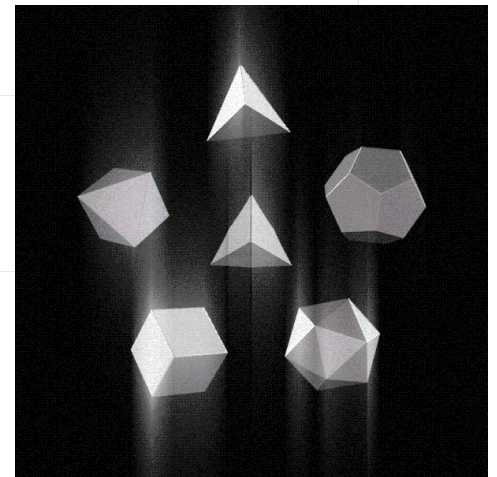
Spring 2022

Course Information and Policies

Course description

This course is an introduction to point set topology. The main topics covered are the following:

- Review of set theory.
- Topological spaces and continuous functions.
- Metric spaces, convergence and completeness.
- Connectedness, compactness and the Tychonoff Theorem.
- Dimension Theory
- Homotopy Theory and The fundamental group.



Lectures

The class meets for 75 minute lectures twice a week. : Schedule: Monday-Wednesday 12:30-1:45 PM. : Location: Hylan 105.

Classes and office hours are held online during the month of January as per the University COVID-19 safety guidelines

Zoom link <https://rochester.zoom.us/j/94466188848>

Zoom link for office hours can be found on Blackboard.

Passcode can be found on Blackboard.

Attendance is not mandatory, but strongly encouraged. Lecture notes will be posted on Blackboard after each meeting.

Instructor

Sergio Chaves

Email: schavesr@math.rochester.edu.

Office hours: Tuesdays 10-11 AM (On zoom),

Wednesdays 2:30-3:30 PM (in-person).

Other times by appointment.

Office: Hylan 1001.

Teaching Assistant

Conor Taliancich

ctalianc@u.rochester.edu

Reach out to our TA through the Blackboard forum.

Textbook

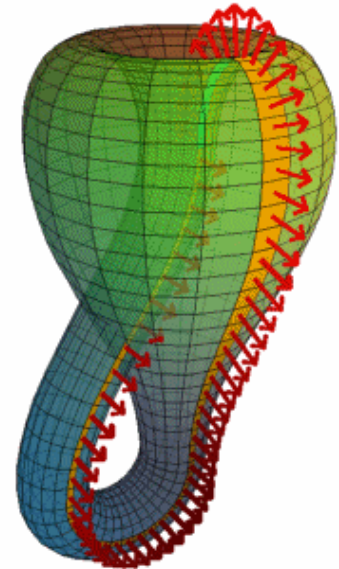
Topology (2nd edition - Pearson - Classic Version 2018) by J. Munkres. ISBN-10 9780134689517.

Any other version of the textbook should work.

Prerequisites

These are strict prerequisites,

- (MATH 171 - MATH 174) or (MATH 161 - MATH 162).
- MATH 200 or MATH 235.
- Permission of instructor.



Homework

Weekly homework will be posted on the course page and collected through Gradescope. You are encouraged to work with other students on the homework problems, but you must write up and submit your own solutions. The two lowest homework scores will be dropped. Late homework will only be accepted with prior arrangements and/or due to exceptional circumstances.

Getting Help

In addition to regularly attending class, you are strongly encouraged to come to office hours. No appointment is necessary to come to office hours --- just drop in! You are welcome collaborate with your classmates (although all work you turn in must be your own!). Use the Blackboard forum to connect with the instructor or TA for help anytime outside office hours!

Finally, some strategies students at UR found successful include the following:

- Always go to class and take good notes.
- Review your notes soon after class --- within the next day or so!
- Read (or at least skim) each section in the text before it is covered in class.
- Do all of the homework thoroughly, write out all of the details, keep it organized, and use it to help you study.
- If you don't understand something, ask right away.
- Go over tests and look at solutions until you know what you did wrong and understand the solution.
- Figure things out rather than memorize them.
- Arrange your schedule so that you have enough time every week to study and do homework.
- Start studying for exams early.
- Get plenty of rest the night before an exam.
- Don't stress out and don't give up!

Academic Honesty

All assignments and activities associated with this course must be performed in accordance with the University of Rochester's Academic Honesty Policy. More information is available at <https://rochester.edu/college/honesty>.

In particular, exams must be submitted with a signed Honor Pledge.

This course is also subject to the Mathematics Department's statement on online resources: Any usage whatsoever of online solution sets or paid online resources (chegg.com or similar) is considered an academic honesty violation and will be reported to the Board on Academic Honesty. In particular, any assignment found to contain content which originated from such sources is subject to a minimum penalty of zero on the assignment and a full letter grade reduction at the end of the semester (e.g. a B would be reduced to a C). This applies even if the unauthorized content was obtained through indirect means (through a friend for instance) and/or the student is seemingly unaware that the content originated from such sources. If you have any questions about whether resources are acceptable, please check with your instructor.

Disability Support

The University of Rochester respects and welcomes students of all backgrounds and abilities. In the event you encounter any barrier(s) to full participation in this course due to the impact of a disability, please contact the Office of Disability Resources. The access coordinators in the Office of Disability Resources can meet with you to discuss the barriers you are experiencing and explain the eligibility process for establishing academic accommodations. You can reach the Office of Disability Resources at: disability@rochester.edu; (585) 276-5075; Taylor Hall; <https://rochester.edu/college/disability>.

Grading

The final grade will be calculated as the maximum of the following two weighted averages.

- Option 1: : Homework: 40% : Midterm 1: 15% : Midterm 2: 15% : Final Exam: 30%
- Option 2: : Homework: 40% : Best Midterm Exam: 20% : Final Exam: 40%

Incomplete grades are almost never given. The only justification is a documented serious medical problem or a genuine personal/family emergency. Falling behind in this course or problems with workload on other courses are not acceptable reasons.

MATH 240HW: For students taking the writing component, refer to the corresponding tab to learn about the grade calculation.

Exams

There will be two midterm exams and one final exam (cumulative). The use of calculators, phones or other electronic devices during exams is prohibited. One page of notes will be allowed during the exams. Makeup exams will only be given in exceptional circumstances.

Exams times and locations

	DATE	TIME	LOCATION
MIDTERM 1	Feb 28	12:30pm	Hylan 105
MIDTERM 2	Apr 4	12:30pm	Hylan 105
FINAL EXAM	May 03	8:30am	TBA

Course Schedule

This is the **tentative** course schedule; there may be small changes as the semester progresses

Week 1 (Wed Jan 12)

Classes start on Wednesday Jan 12.

Sections and topics covered:

- § Introduction and Motivation: Why is topology important?

Week 2 (Wed Jan 19)

No class on Monday (Martin Luther King Jr. Day)

Sections and topics covered:

- § Review of set theory (Chapter 1)

Week 3 (Monday Jan 24 - Wednesday Jan 26)

Sections and topics covered:

- §12 Topological spaces
- §13 Basis for a topology
- §14 The order topology

Week 4 (Monday Jan 31 - Wednesday Feb 2)

- §15 The product topology
- §16 The subspace topology
- §17 Closed sets

Week 5 (Monday Feb 7 - Wednesday Feb 9)

- §17 Boundary, Interior and Hausdorff Spaces
- §18 Continuous functions.

Week 6 (Monday Feb 14 - Wednesday Feb 16)

- §20-21 Metric spaces
- §22 The quotient topology

First midterm material ends here

Week 7 (Monday Feb 21 - Wednesday Feb 23)

- §23 Connected spaces
- §24 Connected spaces of \mathbb{R}
- §25 Components and local connectedness

Week 8 (Monday Feb 28 - Wednesday Mar 2)

- **First Midterm Exam** Monday Feb 28.
- §26 Compactness
- §27 Compact subspaces of \mathbb{R}

Week 9 (No classes)

Spring break: Mar 5 - Mar 13.

Week 10 (Monday Mar 14 - Wednesday Mar 16)

- §28 Limit point compactness
- §29 Local compactness

Week 11 (Monday Mar 21 - Wednesday Mar 23)

- §43 Complete metric spaces
- §45 Compactness in metric spaces
- §46 Convergence in metric spaces

Second midterm material ends here

Week 12 (Monday Mar 28 - Wednesday Mar 30)

- Review of group theory
- §51 Homotopy of Paths
- §52 The fundamental group

Week 13 (Monday Apr 4 - Wednesday Apr 6)

- **Second Midterm Exam** Monday Apr 4.
- §53 Covering spaces

Week 14 (Monday Apr 11 - Wednesday Apr 13)

- §54 The fundamental group of the circle
- Further topics in homotopy theory

Week 15 (Monday Apr 18 - Wednesday Apr 20)

- Manifolds and Surfaces

Week 16 (Monday Apr 25 - Wednesday Apr 27)

- Classification of Surfaces

Last day of classes

Final Exam: Tuesday, May 03, 830am

Other information

LaTeX

This page contains some information about getting started using LaTeX. It is strongly recommended to use it on your homework, and those enrolled in 240HW will be required to use LaTeX to write their papers. You can read the Wikipedia page about LaTeX [here](#).

We recommend using [Overleaf](#) for LaTeX this semester, but if you want to install it locally on your computer, we can recommend TeXshop for Mac or MikTeX for Windows.

Overleaf's site has a nice three part tutorial on LaTeX:

- [Part 1](#)
- [Part 2](#)
- [Part 3](#)

If you want to use a template for your homework assignments or papers, some Googling can help you out. Overleaf has a collection of them [here](#), and the website <https://www.latextemplates.com> contains more.

Problem Solving and Writing Proofs

Solving mathematics problems often requires a lot of time and effort, knowledge, patience and hard work. As this is a Honors class. Writing proofs is different from problem solving; it is a coherent well-written argument intended to convince an audience that something (that follows from

established *hypotheses*) it is true. As this is a Honor class, independent problem solving and coherent writing skills make a huge component of the final grade. [Here](#) are a few ideas that may be useful to keep in mind when you are trying to solve a problem.

Written Component

For students enrolled in the written component, the 80% of your final grade will be calculated as outlined in the [Grading section](#). The remaining portion of your grade corresponds to two written projects (10% each). Your submission must be a PDF document (written in LaTeX) uploaded to gradescope. Since there is a peer-review component, extensions won't be granted unless extenuating circumstances.

Project 1: Separation axioms in topology

The instructions for the first project are available [here](#).

The peer review questions are found in Gradescope.

The deadlines and grading scheme for the first project are as follows:

- First draft (due Friday, 02/25): 30 points
- Peer review (due Friday, 02/04): 20 points
- Final draft (due Wednesday, 03/16): 50 points

Project 2: Introduction to homology

The instructions for the second project are available [here](#).

The peer review questions will be available soon.

The deadlines and grading scheme for the second project are as follows:

- First draft (due Friday, 04/14): 30 points
- Peer review (due Friday, 04/21): 20 points
- Final draft (due Friday, 04/29): 50 points