MATH 247: Graph Theory
Course Description
Spring 2024

Instructor: John Schmitt
Office: Warner 205
E-mail: jschmitt@middlebury.edu
Office Hours: MWF 10:40am–11:10am, Thursday 1:30pm–3pm, Friday 2:15pm–3:45pm or by arrangement
Course webpage: `http://community.middlebury.edu/~jschmitt/graphtheory.html` and a Canvas page.

Meeting Times:
Section A, MWF, 1:10pm-2:00pm Munroe Hall 317

Course description: A graph (or network) is a useful mathematical model when studying a set of discrete objects and the relationships among them. We often represent an object with a vertex (node) and a relation between a pair with an edge (line). With the graph in hand, we then ask questions, such as: Is it connected? Can one traverse each edge precisely once and return to a starting vertex? For a fixed k, is it possible to color the vertices using k colors so that no two vertices that share an edge receive the same color? More formally, we study the following topics: trees, distance, degree sequences, matchings, connectivity, coloring, and planarity. Proof writing is emphasized.

Textbook: *The Fascinating World of Graph Theory* by Art Benjamin, Gary Chartrand and Ping Zhang. A copy of the text is on reserve in the Davis Family Library. I hope we can read all of it. Your feedback is welcome.

Supplemental Texts available in the library:

- *Introduction to Graph Theory, Second Edition* by Doug West, Prentice Hall, NJ, 2001

- *Graphs and Digraphs*, by G. Chartrand (my mathematical grandpa), L. Lesniak

- *Graph Theory*, by R. Diestel (he also has an on-line text available for free download)

- *Pearls in Graph Theory*, by N. Hartsfield, G. Ringel

- *Graph Theory*, by C. Berge

- There are many others.

Homework: Homework will be assigned on a weekly basis. The content of this course is best learned by *solving problems.* I **encourage you to work together**. However, the write-up of homework solutions *should be done on your own.* Please read my *Thoughts on Homework.* To be clear, the use of generative artificial intelligence is strictly prohibited on the problem sets. The only exception to this rule is when it is specifically required.

Quizzes: I reserve the right to give quizzes. If given, they will be short in length and cover recent homework problems, assigned reading, or class discussion.

Special Needs: If you require special arrangements for class or during tests/exams, please talk to me as soon as possible to make such arrangements. If you are color-blind, please let me know as I like to use colored ink/chalk.

Students who have Letters of Accommodation in this class are encouraged to contact me as early in the semester as possible to ensure that such accommodations are implemented in a timely fashion. For those without Letters of Accommodation, assistance is available to eligible students through the Disability Resource Center. Please contact Jodi Litchfield (litchfie@middlebury.edu or 802-443-5936) or Peter Ploegman (pploegman@middlebury.edu or 802-443-2382), the ADA Coordinators. All discussions will remain confidential.

Etiquette: Beyond basic etiquette, I ask that students not use electronic media devices once in the classroom – this includes cell-phones, laptops, and more. **I wish for our time together to be our time together.**

Grading Percentages:

Homework/Quizzes	25
Midterm 1	25
Midterm 2	25
Midterm 3 (Final)	25

Assignment of Grades:

The assignment of grades will follow the scheme below *at a minimum.*

90 and above	A
80 - 89	B
70 - 79	C
60 -69	D
below 60	F

Plus and minus will be determined at the end of the semester.

Midterm Exams:
Schedule:
Midterm 1: Thursday, October 12 at 7:30pm
Midterm 2: Thursday, November 14 at 7:30pm

Final Exam:
Thursday, December 12, 7pm–10pm
The final exam will be administered **at this time only**, please make plans accordingly.

Absences: Please see me as far in advance as possible for absences that will occur on the day of an exam. Any such absences, or unforeseen ones, must be documented in writing by the appropriate person.

Honor Code: The Honor Code will be observed throughout this class, for all examinations and for all homework problems. If you have a question about how the Honor Code applies to this class please ask; please see my *Thoughts on Homework* for more details.

Research: Graph theory is an important component of my research agenda. Students who complete the course may have future opportunities to work with me in this direction. To demonstrate that there are many unsolved problems, you might consult this list,
http://www.openproblemgarden.org/category/graph_theory.

Outline of Topics

1. Introduction, basic terminology and motivational problems

2. Distance in graphs

3. Trees

4. Eulerian graphs

5. Hamiltonian graphs

6. Graph factorization

7. Graph decomposition

8. Oriented graphs

9. Graph drawing

10. Graph coloring

Some goals of the course are:

- gain an understanding of the fundamental concepts of graph theory,

- gain an understanding of when a graph is a useful mathematical tool to solve problems in mathematics, the sciences and the environment,

- develop the ability to write a logical and coherent proof, including proof by contradiction and induction,

- introduce topics related to my own research area and suitable for your possible future research participation, and

- develop a desire for further study in related areas, including combinatorics and computer science.