MATH 491, Spring 2025: Mathematics Capstone

Instructor Dr. Karin Saoub
Trexler Hall 270C
Phone: (540) 375-2348
Email: saoub@roanoke.edu

Class Meetings Tuesdays, Thursdays: 1:10 - 2:40 PM in Trexler 374

Expected Work Hours This course expects you to spend at least 12 hours of work each week inside and outside of class.

Office Hours

Mondays, Wednesdays, Fridays	9:30 AM – 10:15 AM
Tuesdays, Thursdays	10:00 AM – 11:00 AM

Other times available by appointment

About the Course This course is designed to summarize and extend the mathematical knowledge you've obtained at Roanoke College. We will begin by reviewing the math major, discussing why each of you chose to major in math, and present on a small fun topic. These smaller assignments will help prepare you for two large items at the end of the course - a final research project and the Math Inquisition. The former will bring together the theoretical and applied perspectives of mathematics, whereas the latter is a comprehensive oral exam given by the mathematics faculty asking you to articulate what modern mathematics is, how it relates to classical mathematics, what roles theoretical and applied mathematics play, and how technology is utilized.

Intended Learning Outcomes By the end of this course, successful students will be able to:

- understand and appreciate the interplay between applied mathematics and theoretical mathematics,
- state important results from the required classes in the mathematics major,
- form connections between the required classes in the mathematics major,
- explain mathematics and mathematical concepts both orally and in writing.

Prerequisites Two of MATH-361, MATH-371, MATH-381 must be taken prior to taking this course.

Course Grades The following table lists the weights for the various forms of assessment for this class.

Math Major Content Presentation	10%
Why Math Major? Presentation	10%
General Presentation	10%
Research Summary Paper	10%
Background Presentation	10%
Final Presentation	25%
Final Paper	25%

A grade scale will be determined after final grades are computed, but will be no worse than the scale given below. Attendance and class participation will be considered when determining marginal grades.

		B+	87-89	C+	77-79	D+	67-69		
A	93-100	B	83-86	C	73-76	D	63-66	F	0-59
A-	90-92	B-	80-82	C-	70-72	D-	60-62		

Academic Integrity & AI

Students are expected to adhere to the Academic Integrity policies of Roanoke College. As in real life, failure to learn the rules is not an excuse. Please contact me if you have any questions. Be aware that I am contractually obligated to report students if I suspect that they have engaged in academic dishonesty.

During in-class activities, it is fine – and even encouraged – to discuss and learn from one another. However, unless specifically stated otherwise, you are expected to individually complete all steps of the activity and to turn in your own work. All written assignments (unless specifically stated otherwise) are to be completed individually. Misrepresentation of your contribution to a group effort will be considered a violation of the Academic Integrity policy. Copying and pasting directly from a web site and claiming it as your own work is the same as copying and pasting directly from a book – both are violations of the academic integrity policy and will be treated accordingly.

Since a central goal of this subject is to help you become independent and critical thinkers, you are discouraged from using AI tools to create your solutions and proofs for your assignments (problem sets, quizzes, responses, etc). Any work submitted using AI tools will be treated as though it was plagiarized.

If any part of this is confusing or uncertain, please reach out to me for a conversation before submitting your work.

Attendance & Make-Up Work

Attendance is critical in this course. Many days include presentations and discussions that cannot be made-up. However, you should not attend class if you are ill.

When absent, excused or unexcused, you are responsible for all material covered in class. You will not be allowed to make up any work missed due to an unexcused absence.

No late work will be accepted unless you have contacted me prior to the due date and obtained permission to turn in late work. Permission will be granted only for rare circumstances outside your control, such as illness. Do not wait until the last minute to submit work that is due online.

Participation

We will strive to have an active, rather than passive, classroom environment. Failure to attend required classes or be an active participant in class discussions will result in a lowering of your final grade by up to 10 points.

MCSP Conversation Series

The MCSP Department offers a series of discussions that appeal to a broad range of interests related to these fields of study. These co-curricular sessions engage the community to think about ongoing research, novel applications and other issues that face our discipline.

Members of this class are invited be involved with all of these meetings; however participation in at least **three** of these sessions is mandatory. After attending, submit a one page paper reflecting on the discussion. This should not simply be a regurgitation of the content, but rather a personal contemplation of the experience. If you are caught leaving the talk early or being disruptive, you will receive a 0 on the assignment. For each missing reaction paper you will receive a 1 point deduction from your final course grade. Any additional reaction papers beyond the two required will add 0.5 points to your final course grade.

Accessible Education Services

AES located in the Goode-Pasfield Center for Learning and Teaching in Fintel Library. AES provides reasonable accommodations to students with documented disabilities. To register for services, students must self-identify to AES, complete the registration process, and provide current documentation of a disability along with recommendations from the qualified specialist. Please contact Becky Harman, Assistant Director of Academic

Services for Accessible Education, at 540-375-2247 or by e-mail at `aes@roanoke.edu` to schedule an appointment. If you have registered with AES in the past and would like to receive academic accommodations for this semester, please contact Becky Harman at your earliest convenience to schedule an appointment and/or obtain your accommodation letter for the current semester.

Classroom Etiquette

I consider this classroom to be a place where you will be treated with respect, and I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability – and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.

I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records.

Course Components

General Presentation

One of the major goals of Math Seminar is to further develop your oral presentation skills related to mathematics. The first presentation of this class will be a presentation on any topic you wish; a good starting place to find a topic will be the Martin Gardner archive of problems and solutions, which will be provided, if needed. This will be done individually and designed to take about 20–30 minutes. These will be graded by a mix of audience and instructor feedback. Note that while general presentation skills will be assessed, a major focus of the talk is clarity in the exposition of the mathematics.

Major Review

The second part of this class will involve giving a presentation to the class regarding one piece of our review of the mathematics major at Roanoke College; you will review your chosen topic and present to the class the main concepts and ideas from that topic. Note that you should focus on the "big ideas" from the topics and the relationship of your topic to other courses in the major. For example, when talking about Linear Algebra, it is less important to spend time on how to row-reduce matrices rather than why you would row-reduce matrices and what that can tell you about a system of equations. This presentation will be graded partly by audience feedback and partly by the instructor. You should target a length around 30–40 minutes.

Note that this is excellent preparation for the Inquisition which is an oral review of the mathematics major, done individually, in front of the mathematics faculty after Spring Break. The primary goal of the Inquisition is for the faculty to assess the mathematics program as a whole; participation in the Inquisition is required and failure to participate will result in a course grade of F.

Why Major in Math?

The third presentation for this class will be a short presentation (around 5-10 minutes) on why one should choose to major in mathematics. You may talk to each other to get ideas, but you will create these individually. The target audience for this presentation is Roanoke College freshmen or prospective students and it will again be graded by the instructor and audience feedback. Be creative!

Final Research Project

The 2015 CUPM (Committee for Undergraduate Programs in Mathematics) of the MAA (Mathematical Association of America) guidelines describe a national trend for what concepts and skills mathematics majors should have by the end of their undergraduate program. At Roanoke College, we feel that these guidelines are entirely appropriate and have done a great job of meeting the guidelines from the CUPM. In the 2015 edition, one cognitive recommendation is that "students should learn to link applications and theory" and while we do a good job on each of these individually, there is no class or series of classes that expressly has students link the two. One of the best times to have students link applications and theory is after students have had a lot of development in both, and that time is now.

Your major project this semester is very broadly defined. You will complete, either individually or in a group of three, a research project that links applied mathematics and theoretical mathematics. To start, you will reflect upon the courses you have taken and find a favorite topic from either an applied course or a theoretical course and then research and explore the opposite side of the same topic. The result will be a paper and presentation on the topic that you have chosen. To help you reach that point, several checkpoints are present in the class to keep you focused:

- Early in the semester you will submit a short list to the instructor with your favorite applications and theoretical results in mathematics, and why you have enjoyed those items. The reviews of the major and why you chose to major in math should help in crafting this list.
- You will find research papers in mathematics journals regarding these items and type a short report on the papers that you find (at least one journal article per person is required). This will be due before Spring Break.
- Late in March you will give a Background Presentation on your project. The focus here is to make sure that you've learned the background material well-enough so that you can proceed forward. It also gives you a chance to practice your presentation skills related to your topic. Note that, at this point, the link between applications and theory should begin to take shape but may not be fully developed.
- Three times in March and April, there will be days where, instead of class, you will have an individual meeting with me to discuss progress on your project; a first draft of your paper will be due at the beginning of April.
- Your final paper will be due at the time of the final exam time block for this class (Tuesday April 29); the presentation itself will happen either Tuesday or Thursday of the last week of regularly scheduled classes. You should plan to talk for 20-25 minutes, including allowing time for questions.

Tentative Course Schedule

Note: Dates in red require all class members in attendance and those in gray indicate no class meeting. Dates in blue indicate small/individual meetings and you are only required to attend your scheduled time.

Week	Date		Topic
1	Tue	Jan 14	Introduction: Course Format, Major Review, and Legos
	Thu	Jan 16	Discussion of General Presentations
2	Tue	Jan 21	Check-ins
	Thu	Jan 23	No-Class Meeting - Work Day
3	Tue	Jan 28	General Presentations
	Thu	Jan 30	No Class Meeting - Work Day
4	Tue	Feb 4	Presentations - Calculus (Rafe) and Discrete (Trey)
	Thu	Feb 6	Presentations - Linear Algebra (Wes)
5	Tue	Feb 11	Final Project Discussion
	Thu	Feb 13	Check-in
			Group Rosters and Potential Topics for Final Project due by midnight
6	Tue	Feb 18	No Class - Work Day
	Thu	Feb 20	Presentations - Bridge Courses (Wes)
7	Tue	Feb 25	Presentations - Applied (Trey) and Theoretical (Rafe)
			Research Summary Report for Final Project due by midnight
	Thu	Feb 27	Why Major in Math Presentations
			SPRING BREAK
8	Tue	Mar 11	Final Project Check-ins
	Thu	Mar 13	Inquisition Prep
9	Tue	Mar 18	Inquisition
	Thu	Mar 20	No Class - Work Day
10	Tue	Mar 25	Background Presentations
	Thu	Mar 27	No Class - Work Day
11	Tue	Apr 1	Final Project Check-ins
	Thu	Apr 3	No Class - Work Day
			First Draft due by 3pm
12	Tue	Apr 8	Final Project Check-ins
	Thu	Apr 10	Final Project Check-ins
13	Tue	Apr 15	No Class - Work Day
	Thu	Apr 27	Final Project Presentations
14	Tue	Apr 22	NO CLASS - This is a Friday Schedule
	Wed	Apr 23	Reading Day
	Tue	Apr 29	*Final Paper due by 10AM*