

Math 225 (Foundations of Advanced Mathematics)
Section 001, Spring 2022
3 Credit Hours

Instructor: Jo-Ann Cohen (I would prefer to be called Jo-Ann or Dr. Cohen. My pronouns are she/her.)

Office: SAS 3272

Phone: 919-513-4106

Email Address: cohen@ncsu.edu

Office Hours (by Zoom): Monday, Wednesday, and Friday: 2:30-3:30 p.m., and by appointment. To join my office hours via Zoom, use:

<https://ncsu.zoom.us/my/joanncohen>

Course Meeting Time: Monday, Wednesday, and Friday from 11:45 a.m. to 12:35 p.m. (in SAS 2235)

Prerequisite: MA 241

GEP Category: This course does not fulfill a General Education Program requirement.

Materials/book: The notes are on the course website. (There are no additional charges for the notes or for the course.)

Catalog Description: Introduction to mathematical proof with focus on properties of the real number system. Elementary symbolic logic, mathematical induction, algebra of sets, relations, functions, countability. Algebraic and completeness properties of the reals.

Student Learning Objectives/Outcomes

Math 225 was originally developed:

- (i) to help prepare you for upper level mathematics courses, especially courses such as abstract algebra (MA 403 or 407) and mathematical analysis (MA 425-426) that rely on the understanding and communication of mathematics, and
- (ii) to help you decide if majoring in mathematics or applied mathematics is a good fit for you.

We will focus most of our attention on constructing and critiquing mathematical arguments and proofs, communicating mathematics, developing mathematical conjectures, and mastering basic definitions, concepts, and mathematical results, especially those used in upper level mathematics courses. Below we provide more detail on what students are expected to be able to do by the end of the course.

By the end of MA 225, students should be able to:

1. generate clearly reasoned, convincing proofs.
 - Students should be able to construct proofs using direct arguments, contradiction, and the Principle of Mathematical Induction and equivalent principles.

- Students should be able to move successfully from the discovery of a proof to the writing of a proof.
 - Students should be able to construct a proof in such a way that the reader can follow the steps logically from one to another and is convinced of the validity of the proof.
 - Students should be able to show that they possess a sound understanding of the underlying mathematics as revealed in the construction of proofs.
2. read, understand, and make informed judgments about mathematical arguments.
 - Students should be able to identify the basic methods of proof such as direct proofs, proofs by contradiction, and proofs using the Principle of Mathematical Induction and equivalent principles.
 - Students should be able to analyze and critique mathematical arguments. Students should be able to make a sound case as to the correctness of the argument, should be able to explain any problems that are found, and then should be able to suggest ways to remedy the problems.
 3. clearly communicate mathematics (in both written form and oral form) at the appropriate levels for the audience.
 4. understand and use mathematical language and symbols.
 - Students should be able to express mathematical concepts using precise mathematical symbols and prose.
 5. explore examples and make conjectures.
 6. understand the basic definitions and properties of selected mathematical concepts beyond calculus and high school material.
 - Students should be able to use these definitions and properties in the construction of proofs.

Course Structure and Rules of Engagement: The lectures will be interspersed with small group activities. The course will be structured so that there is a lot of student interaction. In this class we will share ideas and learn from each other. It will be important for each of you to “try” on new ideas and to make conjectures even if you are not sure that you are correct. You will also be asked to critique the ideas and arguments of others. While it is OK to disagree with those ideas and arguments, it is not OK to make personal attacks.

Email: All emails will be sent to your official ncsu.edu email address.

Course Schedule: I will usually assign homework each week and will collect homework every 7-10 days. The topics we will cover and the order in which we will cover them are listed below. The pace of the course depends upon your interests and input. The flexibility in the course topics schedule enables us to pursue your ideas, your conjectures, and your proofs.

Chapter 0. Preliminaries: 1-2 days

Chapter 1. Language, Logic, Sets, and Methods of Proofs: 3-6 weeks

Chapter 2. The Principle of Mathematical Induction: 2-3 weeks

Chapter 3. Functions: 2-3 weeks

Chapter 4. Equivalence Relations: 2-3 weeks

Chapter 5. The Size of Sets: 1-2 weeks (if time)

Note that the above course schedule is subject to change.

Grading:

- | | |
|---|-----|
| 1. Homework Assignments | 10% |
| 2. Three Hourly Exams (20% each) | 60% |
| Tentative Dates: | |
| Wednesday, February 9 th | |
| Friday, March 11 th | |
| Monday, April 18 th | |
| 3. Final Exam | 30% |
| Wednesday, May 4, 2022, 12:00-2:30 p.m. | |

Important Notes. 1. If your final exam score is higher than your lowest hourly exam score, I will replace your lowest hourly exam score by the average of your final exam score and your lowest hourly exam score.

2. On your homework assignments, all problems assigned should be done independently unless I explicitly let you know that you may work together.

3. On your homework assignments and tests, you must always justify your answers and write in complete sentences.

Standard Grading Scale: I will use the standard grading scale:

$97 \leq A+ < 100$, $93 \leq A < 97$, $90 \leq A- < 93$, $87 \leq B+ < 90$,
 $83 \leq B < 87$, $80 \leq B- < 83$, etc.

S/U Grading: If you are registered for the S/U grading option, you will need to complete the course and receive at least a C- to pass the course.

Auditing the Course: To audit the course, you must have the approval of your advisor and the Mathematics Department. In order to receive an AU, you must attend the majority of the sessions, and you must take all of the tests. See:

<https://policies.ncsu.edu/regulation/reg-02-20-04/>

for more information concerning course audits.

Incomplete Grades: Incomplete grades will be handled on an individual basis. Note, however, that if an extended deadline is not authorized by an instructor or department, an unfinished incomplete grade will automatically change to an F after either (a) the end of the next regular semester in which the student is enrolled (not including summer sessions), or (b) the end of 12 months if the student is not enrolled, whichever is shorter. Incompletes that change to F will count as attempted courses on transcripts. The burden of fulfilling an incomplete grade is the responsibility of the student. The university policy on incomplete grades is located at:

<https://policies.ncsu.edu/regulation/reg-02-50-03/>.

Attendance Policy/Late Assignments/Make-up Work: You are expected to attend all classes on time. Late assignments and make-up work will only be allowed for excused absences.

You should contact me by email before any anticipated excused absence. If you have an unanticipated excused absence (for example, a medical emergency), you should contact me within one week of returning to class. Together we will develop a plan to help you make up any missed assignments or exams.

For complete attendance and excused absence policies, please see:

<https://policies.ncsu.edu/regulation/reg-02-20-03-attendance-regulations/>.

Health and Participation in Class: We are all concerned about your health, as well as the health of all of our students, faculty, and staff at NC State.

- If you test positive for COVID-19, or are told by a healthcare provider that you are presumed positive for the virus, you should not attend our class or any in-person class. Please also follow other university guidelines, including self-reporting ([Coronavirus Self Reporting](#)). Self-reporting is not only to help provide support to you, but also to assist in contact tracing for containing the spread of the virus.
- If you feel unwell, even if you have not been knowingly exposed to COVID-19, please do not come to in-person classes or activities.
- **Face Coverings:** All members of the NC State academic community are expected to follow all university policies and guidelines for the use of face coverings. Face coverings are required in instructional spaces. Face coverings should be worn to cover the nose and mouth and be close fitting to the face with minimal gaps on the sides.
- Note: If I need to be out for an extended period of time and cannot conduct the class via Zoom, Sarah Strikwerda, one of our wonderful graduate students, will take over in my absence.

COVID-19 Related Absences: If you need to miss class because you have been advised that you may have been exposed to COVID-19 or you have a personal or family situation related to COVID-19 that prevents you from attending our sessions, please contact me. Together we will develop a plan to help you keep up with your coursework during any such absences. COVID 19-related absences will be considered excused. You do not need any additional documentation. (But, again, please make sure you contact me.)

Academic Integrity/Honesty: Students are required to comply with the university policy on academic integrity/honesty found in the Code of Student Conduct:

<https://policies.ncsu.edu/policy/pol-11-35-01/>.

It is my understanding and expectation that your signature on any test or assignment means that you have adhered to the Pack Pledge:

I have neither given nor received unauthorized aid on this test or assignment.

Violations of academic integrity will be handled in accordance with the Student Discipline Procedures ([NCSU REG 11.35.02](#)).

Digital Course Components: In this course we will use Zoom and Moodle. Please see the relevant [technology requirements](#). If you need access to additional technological support, please contact the Libraries' Technology Lending Service ([Technology Lending](#)).

Students may be required to disclose personally identifiable information to other students in the course, via electronic tools like email or web-postings, where relevant to the course. Examples include online discussions of class topics and posting of student coursework. All students are expected to respect the privacy of each other by not sharing or using such information outside the course.

Please be advised this course may at times be recorded for current and potential future educational purposes. By your continued participation in this course, you are providing your permission to be recorded.

Moodle: All materials are housed on the course website in Moodle. I will have you submit most of your homework assignments in Moodle.

Note that I received licenses to include pictures and biographies of the mathematicians and mathematics educators that appear in the notes under the provision that the materials would be housed on a secure site. So although you may copy the notes for your own use, you should not share the pages with the pictures and biographies with anyone else.

Zoom: I will conduct my office hours (Monday, Wednesday, and Friday from 2:30 p.m. to 3:30 p.m., and by appointment) via Zoom. Here is the link for office hours:

<https://ncsu.zoom.us/my/joanncohen>.

Diversity, Equity, and Inclusion: Diversity, equity, and inclusion are important to the success of our students at NC State. Every student, every faculty member, and every staff member who comes to NC State enriches us through their varied perspectives, knowledge, and backgrounds. Our classroom is one in which every student is respected and feels heard.

In an effort to affirm and respect the identities of transgender students in the classroom and beyond, please contact me if you wish to be referred to using a name and/or pronouns other than those listed in the student directory.

I have benefited throughout my life from my majority status, the most impactful of which has been my white privilege. I know that our students of color face issues that I have never faced, nor will ever face. Moreover, I recognize that all of my students have unique experiences that I have not had. I want to affirm that I will listen to your experiences if you would like to share them with me. I want to create a learning environment in which my students feel safe and heard. I value your perspectives and I will advocate for your needs in our department and throughout the university.

I welcome any additional suggestions you have for making our classroom more welcoming and inclusive.

Accommodations for Disabilities: Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with the Disability Resource Office at Holmes Hall, Suite 304, 2751 Cates Avenue, Campus Box 7509, 919-515-7653. For more information on NC State's policy on working with students with disabilities, please see the [Academic Accommodations for Students with Disabilities Regulation \(REG02.20.01\)](#).

Non-Discrimination Policy: NC State prohibits discrimination, harassment, and retaliation based on a person's age (40 years or older), color, disability, genetic information, gender identity, national origin, race, religion, sex (including pregnancy), sexual orientation or veteran status. If you feel that you have been the subject of prohibited discrimination, harassment, or retaliation, you should contact the Office for Institutional Equity and Diversity (OIED) at 919-513-0574.

NC State's policies and regulations covering discrimination, harassment, and retaliation may be accessed at <http://policies.ncsu.edu/policy/pol-04-25-05> or <http://oied.ncsu.edu/divweb>.

Interpersonal Violence (IPV): NC State is committed to eliminating interpersonal violence (relationship violence, sexual misconduct, sexual harassment, stalking, etc.) on our campus. IPV is **not** tolerated at NC State. It is contrary to our values of ensuring a safe, equitable, and violence-free environment, and is a barrier to achieving health and wellness and student success.

As a member of the NC State faculty, I am committed to creating a safe learning environment in our class, and more generally, a safe environment for you to help you learn, work, live, and thrive. Should you experience interpersonal violence, know that it is not your fault and you are not alone. Please know that I am here for you if you would like to talk with me.

NC State Women's Center is a wonderful resource and has trained advocates available to offer crisis intervention, emotional support, resources, and referrals for all students. For more information on advocacy services, please visit go.ncsu.edu/supportsurvivors. If you would like to talk to a confidential resource, please connect with the [NC State Counseling Center](#) at 919-515-2423.

Health and Well-Being Resources: These are difficult times, and academic and personal stress are natural results. I encourage all of you to [take care of yourselves](#) and your peers. If you need additional support, there are many resources on campus to help you:

- Counseling Center ([NCSU Counseling Center](#))
- Health Center ([Health Services | Student](#))
- NC State CARES Team: As members of the NC State Wolfpack community, we each share a personal responsibility to express concern for one another and to ensure that our campus remains a healthy and safe environment for learning. Occasionally, you may come across a classmate whose personal behavior concerns or worries you, either for your classmate's well-being, for your well-being, or for the well-being of

others. When this is the case, I would encourage you to report the behavior to the NC State CARES team: ([Share a Concern](#)).

- If you or someone you know are experiencing food, housing or financial insecurity, please see the Pack Essentials Program ([Pack Essentials](#)).

Community Standards related to COVID-19: We are all responsible for protecting ourselves and our community. Please see the [Community Standards](#) and Rule 04.21.01 regarding Personal Safety Requirements Related to COVID-19 ([RUL 04.21.01 – Personal Safety Requirements Related to COVID-19 – Policies, Regulations & Rules](#)).

NC State Rules and Regulations: Students are responsible for reviewing the NC State University Policies, Rules, and Regulations (PRRs) which pertain to their course rights and responsibilities, including those referenced both below and above in this syllabus:

- Equal Opportunity and Non-Discrimination Policy Statement <https://policies.ncsu.edu/policy/pol-04-25-05/> with additional references at <https://oied.ncsu.edu/equity/policies/>
- Code of Student Conduct <https://policies.ncsu.edu/policy/pol-11-35-01/>

Other Important Resources for Students

- If you find yourself in a place where you need help, academically or otherwise, please review these [Step-by-Step Help Topics](#).
- **Introduction to Zoom for Students:** <https://youtu.be/5LbPzzPbYEW>
- **Learning with Moodle, a student's guide to using Moodle:** <https://moodle-projects.wolfware.ncsu.edu/course/view.php?id=226>
- **Protect the Pack FAQs:** <https://www.ncsu.edu/coronavirus/frequently-asked-questions/>
- **NC State Protect the Pack Resources for Students:** <https://www.ncsu.edu/coronavirus/reactivating-campus/resources-for-students/>
- **Academic Success Center** (tutoring, drop in advising, career and wellness advising): [Academic Success Center](#).