

## MA 225: Foundations of Advanced Mathematics

### Lecture details

Instructor: Alen Alexanderian  
Lecture time/location: Tue/Thurs 3:00–4:15, via Zoom  
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Phone: 919.515.8589  
Office Hours: Wed 2–3 PM and by appointment, via Zoom

### Course Description

Introduction to mathematical proofs 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.

**Prerequisite:** MA 241

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

**Textbook:** We will use notes prepared by Dr. Jo-Ann Cohen at NCSU. The notes are posted in Moodle. (There are no additional charges for the notes.)

**Learning Objectives/Outcomes:** Students should demonstrate the ability to:

1. 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.
2. 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.
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.

**Course Delivery Changes Related to COVID-19:** Please be aware that the situation regarding COVID-19 is frequently changing, and the delivery mode of this course may need to change accordingly, including from synchronous sessions to an asynchronous format. Regardless of the delivery method, we will all strive to provide a high-quality learning experience

Note: If I need to be out for an extended period of time, Dr. Jo-Ann Cohen will take over in my absence.C

### Tentative Course Topics Schedule:

- Chapter 0 Preliminaries: 1-2 days
- Chapter 1 Language, Logic, Sets, and Methods of Proofs: 3-5 weeks
- Chapter 2 The Principle of Mathematical Induction: 2-3 weeks
- Chapter 3 Functions: 2-3 weeks
- Chapter 4 Equivalence Relations: 2 weeks
- Chapter 5 The Size of Sets: 1-2 weeks
- Chapter 6 Further Properties of the Integers: 1 week

### Grading Policy:

The grading will be assigned on a 10-point scale: **A: 90 – 100, B: 80 – 89, C: 70 – 79, D: 60 – 69, F: ≤ 60**. The cutoffs for the +/- grades are determined at the end of the semester. Your final grade in this course will be determined by marks earned on homework assignments (10%) three midterms (20% each) and a final exam (30%).

### Exams:

- Midterm 1: Thursday Sep 17
- Midterm 2: Tuesday Oct 13
- Midterm 3: Thursday Nov 5
- Final exam date: Tue Nov 17, 3:30 PM–6:00 PM.

**Grading/Scheduling Changing Options Related to COVID-19:** If the delivery mode has a negative impact on your academic performance in this course, the university has provided tools to potentially reduce the impact:

Enhanced S/U Grading Option:

<https://studentservices.ncsu.edu/your-resources/covid-19/spring2020-sat-grading/>.

Late Drop:

<https://studentservices.ncsu.edu/your-resources/covid-19/spring2020-latedrop/>

Be aware that if you use the enhanced S/U grading option, you will still need to complete the course and receive at least a C- to pass the course.

In some cases, another option may be to request an incomplete in the course. Before using any of these tools, discuss the options with your instructor and your academic advisor.

**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 hand in all of the homework and 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/Absence 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 or in person 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.

For complete attendance and excused absence policies, please see:

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

**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 Statement and Academic Dishonesty:** 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/>

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

**Cell Phone and Computer Use:** Cell phones should be turned off during class. But if you have an emergency and need to keep your phone on during class, please let me know before class.

**Digital Course Components:** In this course we will use Zoom and Moodle. Please see the relevant technology requirements in

<https://docs.google.com/document/d/1Bfrka-Y4qm3WouAGOnCm0YBAytkTjQjvEBErBkNDgc/edit>.

If you need access to additional technological support, please contact the Libraries' Technology Lending Service: <https://www.lib.ncsu.edu/devices>.

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.

**Moodle:** All reading materials are housed on the course page in Moodle. I will also post videos the recorded lectures in Moodle, as well as .pdf files containing lecture content.

**Zoom:** Our lectures will be conducted synchronously via Zoom. The link to access the Zoom lecture is posted in Moodle page for the course. Typically, I will initially put all of you on “mute”, but if you would like to talk, there is a button on the left side of the Zoom screen that will enable you to unmute yourself. Zoom enables us to have breakout rooms for small group discussions and we will utilize that function as well.

I will be recording our Zoom sessions and will be posting links to the recordings on our Moodle page. I will only record our mathematical discussions and not, for example, the parts of our sessions where we check in with each other. In order that all students in the class feel comfortable asking questions, and making conjectures, etc., you may not share the links with anyone outside of our class.

These recordings are for use in our current class (and possibly for use in future educational purposes). By your continued participation in this recorded course, you are providing your permission to be recorded.

**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 welcome any additional suggestions you have for including the value of diversity, equity, and inclusion in this course.

**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, 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 that are based upon a person's race, color, religion, sex (including pregnancy), national origin, age (40 or older), disability, gender identity, genetic information, sexual orientation, or veteran status (individually and collectively). 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>.

**Health and Well-Being Resources:** These are difficult times, and academic and personal stress are natural results. Everyone is encouraged to [take care of themselves and their peers](#). If you need additional support, there are many resources on campus to help you:

- Counseling Center ([link](#))
- Health Center ([link](#))
- 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](#)).

**Additional COVID-19 Information:** Due to the Coronavirus pandemic, public health measures have been implemented across campus. Students should stay current with these practices and expectations through the Protect the Pack website <https://www.ncsu.edu/coronavirus/>.

We are most concerned about your health and the health of the students, faculty, and staff across campus. If you test positive for COVID-19, or are told by a healthcare provider that you are presumed positive for the virus, please follow 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.

**Community Standards related to COVID-19:** We are all responsible for protecting ourselves and our community. Please see the [community standards](#) (released on 7/28/2020) and [Rule 04.21.01](#) regarding Personal Safety Requirements Related to COVID-19.

**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](#) with additional references at <https://oied.ncsu.edu/equity/policies/>
- [Code of Student Conduct](#)

#### **Important Resources for Students:**

- NC State Keep Learning, tips for students taking courses remotely:  
<https://dasa.ncsu.edu/academics/keep-learning/>
- 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/>