

MA 225-001 Foundations of Advanced Mathematics

Lecture details

Section 001 MWF 9:35 - 10:25, SAS 2102
Instructor: Alina Duca | SAS 2108 | anduca@ncsu.edu | 919.515.1875
Office Hours: Mondays 3:00 - 4:00, Thursdays 3:00 - 4:00, or by appointment
Moodle page: <http://moodle.wolfware.ncsu.edu/>

Course text

How to Read and do Proofs: An Introduction to Mathematical Thought Processes, by Daniel Solow, 6th Edition, Wiley.

Learning Objectives

Upon successful completion of this course, students should be able to:

- Read, summarize, and evaluate written mathematical proofs.
- Construct and write mathematical proofs using standard methods of mathematical proof including direct proofs, mathematical induction, case analysis, and counterexamples.
- Assess the logical coherence and validity of a proof. Generate clear arguments why a result/proof is valid/invalid (e.g. counterexamples, poor notation, inappropriate proof techniques, etc).
- Identify various elements of a theorem, proof, definition. Generate examples, non-examples and counterexamples to analyze theorems and their proofs, and effectively use definitions.
- Communicate mathematical reasoning through clear writing, effective reading comprehension, and persuasive oral communication.
- Identify appropriate mathematical techniques and generate strategies to prove statements from Linear Algebra, Abstract Algebra, and Real Analysis.

How this course works This section of MA 225 is not set up according to the traditional classroom model of lectures and examples in class, followed by homework outside of class. Instead, a lot of times you will be expected to acquire basic familiarity with new concepts before coming to class through a variety of means provided to you through Moodle. During the first two thirds of the semester we will remove part of the lectures from the classroom, freeing up time for us to deal with things that matter: answering questions, working on hard problems with each other, and hammering out an understanding of the material that cannot be conveyed by some person talking to you. Towards the end of the semester we will focus on introducing you to the upper-level, proof-based mathematics topics. We will do in-class activities (individual and group) focusing on applying the proof techniques learned in the first part of the semester to proofs of basic statements from upper level math classes.

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 the final exam, three term tests, online homework assignments, and in-class quizzes. The weighting of these components are as follows:

Homework = 20 %
Portfolio = 10 %
Three term tests = 45 %
Final Exam = 25 %

Note: I do NOT curve grades in this course. It is theoretically possible for everyone in the class to get an A (or an F). Your performance depends only on how you do, not on how everyone else in the class does. It is therefore in your best interests to help your classmates, while keeping the academic integrity policy in mind.

Term Tests 45%

There will be three closed book, closed notes in-class term tests: September 18 (Monday), October 13 (Friday), November 17 (Friday). *No re-tests* will be given. If you miss a test because of an undocumented or unexcused absence, a zero will be entered for that test grade. Students who are unable to take the test at those times (with a documented excuse (not just that you don't want to) will schedule an alternate time to take the exam.

Final Exam 25%

The final exam is mandatory, cumulative and will be held in the usual classroom. The only way to take the final exam at another time is to request a change through the Department of Registration and Records, 1000 Harris Hall.

Homework 20 % It is recommended that you try to type your homework assignment in LaTeX. Resources for typing in LaTeX are provided in Moodle. Please read the Moodle resource called *How to write a solution - great tips from "Art of Problem Solving"* for homework formatting and good practices when writing proofs. The lowest 2-3 homework grades will be dropped at the end of the semester. Use these drops wisely.

Portfolio 10%

A major goal of MA 225 is to learn how to solve problems whose solutions involve well-written and convincing mathematical arguments. This goal involves fusing together a mastery of mathematical techniques and skill with writing arguments in a clear and compelling way. The primary tool we will use to build your problem-solving skills, assess your work at problem-solving and writing, and to showcase your progress and mastery is the **Portfolio**.

Over the course of the semester, students will receive ten problems whose solutions involve crafting coherent, convincing, and mathematically correct arguments, also known as *proofs*. These problems are sometimes difficult and always require careful thought, lots of attention, and lots of time to think and make mistakes. You will be working on these problems individually outside of class, writing up drafts of your solutions, submitting those drafts, receiving feedback on your drafts, and repeating this draft/feedback/revision cycle on each problem until you have a completed solution. By the end of the semester, you will have a complete package of ten-twelve proof-oriented problems and formal, correct, professionally-typeset solutions to them.

Corrections to the grading

If you believe an error has been made in grading on a test and you should have gotten more points than you got for any reason other than a simple addition error, write a statement making your case, attach it to the test and give it to me no later than *1 week after the test is returned*. Do not alter the original work!

Test Make-Up Policy

All *anticipated absences* must be excused in advance of the test date. These include university duties or trips (certified by an appropriate faculty or staff member), required court attendance (certified by the Clerk of Court), or religious observances (certified by the Department of Parent and Family Services 515-2441). *Emergency absences* must be reported as soon as possible once returning to class and must be appropriately documented (illness by an attending physician or family emergencies by Parent and Family Services). If you are sick on a test day and decide not to come to class, go to the health center or other medical facility. Students who miss a test and have a university-approved excuse must submit appropriate documentation.

Attendance is expected every day as it is critical for the understanding of the material and not attending class serves as its own penalty because this material takes much longer to learn independently. You are responsible for keeping up with missed work so that you do not fall behind. Office hours will not be utilized to re-teach material presented in class.

Instructor's commitment

You can expect your instructor to be courteous, punctual, well organized, and prepared for lecture and other class activities; to answer questions clearly and in a non-negative fashion; to be available during office hours or to notify you beforehand if they are unable to keep them; to provide a suitable guest lecturer when they are traveling; and to grade uniformly and consistently according to the posted guidelines.

The Math Multimedia Center is a tutorial center for undergraduate students that need help in their mathematics courses (100- through 300-level), and is staffed by math graduate students familiar with the material taught in these courses.

Location: SAS Hall 2103/2105

Hours: Monday - Friday 8:00 am - 5:00 pm

Add/Drop Regulation

Undergraduate students are expected to complete all courses for which they are enrolled as of census date (the official enrollment date defined as the 10th day of fall and spring terms and the 3rd day of summer terms). Undergraduate course drops after census date will now be considered to be course withdrawals and will result in W grades on the transcript. Undergraduates will be limited to a maximum of 16 hours of course withdrawals after census date and before the drop date Friday, October 13, 2017 for their entire undergraduate career at NC State. These course withdrawals will count as attempted hours for course repeat, financial aid satisfactory academic progress, and tuition surcharge calculations.

Students with disabilities

“Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with Disability Services for Students at 1900 Student Health Center, Campus Box 7509, 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 (REG02.20.1)”

Student Evaluations

Online class evaluations will be available for students to complete during the last three weeks of classes. You will receive an email message directing you to a website where you can login using your Unity ID and complete the evaluation. All evaluations are confidential; instructors will not know how any one student responded to any question, and students will not know the ratings for any instructors.

Academic Integrity Statement and Academic Dishonesty

Both faculty and students at North Carolina State University have a responsibility to maintain academic integrity. An informational brochure about academic integrity is available from the university and students are encouraged to obtain a copy.

”Academic dishonesty is the giving, taking, or presenting of information or material by a student that unethically or fraudulently aids oneself or another on any work which is to be considered in the determination of a grade or the completion of academic requirements or the enhancement of that student’s record or academic career.” (NCSU Code of Student Conduct)

Scholarly activity is marked by honesty, fairness and rigor. A scholar does not take credit for the work of others, does not take unfair advantage of others, and does not perform acts that frustrate the scholarly efforts of others. The violation of any of these principles is academic dishonesty. Penalties for a violation: For the first violation, you will receive a zero for your work and be put on academic integrity probation for the remainder of your stay at NCSU. The second violation may result in your suspension from NCSU. Both situations will involve the Office of Student Conduct.

Other Remarks

- You are more than welcome to visit me during my official office hours, but I am available at many other times (just before class is usually not a good time, however). Please make an appointment if necessary.
- A good way to contact your instructor is by email. Please make sure that you include your name and the course number and section in subject line of your email.
- Your email address registered with the NCSU online directory will be used for announcements associated with this class. It is your responsibility to maintain a valid email address and check/empty your Inbox regularly.
- The test grades will be recorded in the gradebook in Moodle. The grades for the WeBWorK assignments will be transferred to Moodle at the end of the semester. Please notify me immediately if you notice any discrepancies in your grades. Keep all your quizzes and tests for future reference.
- Please check the course webpage regularly, as it will be continuously updated with announcements, any changes in the schedule, homework problems, solutions, review sheets, and other additional course materials.
- Please mark the test dates on your calendar and do not set your dental/doctor/interview... appointments on top of the test dates.
- Be respectful to your peers and to your instructor. All cell phones should be turned off during class and no eating, drinking, or any tobacco products are allowed in the classroom. Please leave your laptop in your bag during class time. Students who do not follow these guidelines may be asked to leave class.

Course content

- What is a statement? What is a proof? (2 lectures)
- The Forward-Backward Method (2 lectures)
- On Definitions and Mathematical Terminology. Introductory definitions and notations: sets and functions. (4 lectures)
- The Construction Method (existential quantifier) (2 lectures)
- The Choose Method (universal quantifier) (3 lectures)
- Specialization (universal quantifier) (2 lectures)
- Nested Quantifiers. (2 lectures)
- Negating statements. (3 lectures)
- The Contradiction Method. (2 lectures)
- The Contrapositive Method. (1 lecture)
- The Uniqueness Method. (1 lecture)
- Mathematical Induction. (2-3 lectures)
- The Either/Or Methods. (1 lecture)
- The Max/Min Methods. (optional)
- Review of proof techniques. (2 lectures)
- Creating Mathematical Definitions (convergent sequence, group). (3-5 lectures)
- Generalization (limit of a function at a point, infinite limit of a function, limits at infinity). (2 lectures)
- Axiomatic Systems. Relations, equivalence relations, and equivalence classes. (3 lectures)
- Optional topics may be discussed if time permits (proofs from Discrete Mathematics, Cardinality, Linear Algebra, Modern Algebra, Real Analysis)

Good Luck!