

Foundations of Mathematics (3)

Dr. Caldwell, Fall 2016

Instructor: Dr. Chris K. Caldwell (caldwell@utm.edu), office 429 Humanities (drop by!) This semester we will try piazza (instead of e-mail) as the main way way for you to ask question outside of class or my office—you should have already received an invitation by e-mail. We may discuss the pedagogical reasons for this on the first day of class.

Prerequisite: Math 251 or departmental approval.

Catalog Description: Proof techniques, sets, propositional calculus, functions, relations, properties of integers. *(In other words: this is our first course in writing proofs, a skill used in most of our upper division classes.)*

Learning Outcomes for Major: This course addresses (as assesses) student learning outcomes iii and iv for the major. (There is additional information about this assessment on line at math.utm.edu such as the UTM Proof Outlines.)

Upon completion of his/her degree from the University of Tennessee at Martin with a major in mathematics, the graduate will be able to:

- i. apply mathematical concepts and principles to perform numerical and symbolic computations;
- ii. use technology appropriately to investigate and solve mathematical and statistical problems;
- iii. write clear and precise proofs;**
- iv. communicate effectively in both written and oral form;**
- v. demonstrate the ability to read and learn mathematics and/or statistics independently.

Teaching Objectives: The student will:

1. Understand abstract definitions by analyzing them carefully and constructing examples
2. Recognize a rigorous proof
3. Identify and correct weaknesses in invalid and incomplete proofs
4. Construct proofs using a variety of proof techniques including: direct proofs, proofs by contraposition and contradiction, proofs by mathematical induction
5. Present proofs both orally and in written form using correct and concise English and mathematical grammar
6. Understand and apply the basic terminology, notation, and concepts associated with each of the following areas:
 - (a) the algebra of sets
 - (b) propositional calculus (including quantifiers)
 - (c) relations (especially equivalence and recurrence relations)
 - (d) the algebra of functions (especially in/sur/bi-jections)
 - (e) properties of the integers (including division algorithm, gcd, prime factorization)

Text(s): Book of Proof (edition 2.2), Richard Hammack, Virginia Commonwealth University, available from the author for free at <http://www.people.vcu.edu/~rhammack/BookOfProof/> or a printed version as ISBN: 978-0-9894721-0-4.

Outline:	Chapter	Title (Sections)	Days
	1	Sets (1–8)	5
	2	Logic (1–10)	6
	4	Direct proof (1–5)	2
	5	Contrapositive proof (1–3)	2
	6	Proof by contradiction (1–4)	2
	7	Proving Non-Conditional Statements (1–4)	1
	8	Proofs involving sets (1–3)	2
	9	Disproof (1–3)	1
	10	Mathematical Induction (1–3)	3
	11	Relations (1–5)	4
	12	Functions (1–5)	5
	3 or 13	Counting or Cardinality	4
		One period tests	4
		Total days	<hr/> 41

Goal: To prepare students for success in upper division proof-based mathematics courses by familiarizing students with the basic notations, definitions, and proof styles of mathematics.

Grading: It is unlikely tests . . . will be graded 90% A, 80% B, . . . ; but numerical grades will be determined using the following weights.

- 53% tests (about four one period tests)
- 23% homework (proofs assigned most days)
- 19% final (comprehensive)
- 5% participation (classroom board work and discussion, meta assignments)

Homework: Homework will be collected the day it is due at at the beginning of the class period—have it ready. You may turn your homework in early. For each hour (or significant fraction thereof) your homework is late in reaching me, it will lose 5% of its value. The homework list is online.

Attendance: Attendance is mandatory and is enforced via the participation grade.

Trigger Warning: Expect to work in this class (and expect to gain significantly from that work!) Undergraduate classes are meant to require two hours of work outside of class for each hour in class. Upper division mathematics and statistics courses usually require more. I will be respectful of your time and endeavor to use it in a way that is very beneficial to you.

Academic Integrity: Academic dishonesty will not be tolerated and will result in at least an F for the activity or assignment. Your Student Handbook clearly states “suspension from the university is the expected penalty” for “plagiarism, cheating, and academic integrity issues” and this includes submitting the work of another person as your own or permitting another to submit yours as his/her own. For this course especially, make sure that you know what plagiarism is.

Disability Services: The University of Tennessee provides reasonable accommodations (academic adjustments and auxiliary aids) to ensure equal access to educational content and university programs for students with disabilities. Students who are eligible for and who request accommodations through the Disability Services office must provide instructors with a letter of accommodation. The Disability Services office is located in the Student Success Center, 203 Clement Hall, (731) 881–7605.