Textbook: The Tools of Mathematical Reasoning, by Tamara J. Lakins; AMS Pure and Applied Undergraduate Texts #26
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Course Description: Logic, rules of inference, methods of proof including direct and indirect methods, sets, functions, and mathematical relations and properties of relations.
Pre/Co-requisite: Calculus II must be taken prior to or with Math 311.

Course Requirements: The primary purpose of this course is to introduce you to the basic techniques and methods used to write mathematical proofs. Unlike many of your previous experiences with mathematical proofs, this course is not designed to be a spectator sport. While watching your instructor do model proofs can be helpful as a starting point, the best way to learn to write proofs is to actively explore the related concepts and ideas, to build intuition by working out special cases or motivating examples, to bounce ideas off of your classmates, and to write, rewrite, present, revise, and perfect your own proofs. Since every mathematical proof is about some aspect of mathematical content, we will also learn or revisit a fair amount of related mathematical content along the way, but developing our proof-writing abilities will be the central concern of this course.

Major Content Areas:
- Sets and set operations
- Equivalence relations
- Partial orderings
- Proof methods and strategies
- Functions
- Relations and the properties of relations
- Representations of relations
- Rules of inference and an introduction to proofs

Student Learning Outcomes:
- Understand and use rules of inference to prove statements.
- Work with sets, and understand how sets form a basis for relations and functions.
- Prove a variety of results using both direct and indirect proof methods.
- Prove results using Mathematical Induction.
- Understand basic notions of relations, equivalence relations, partial orderings, and partitions.
- Understand the axiomatic nature of mathematics.

Course Requirements: This class may be a bit different from other math content courses that you have taken. This course will focus on using active learning and an "exploratory" or "inquiry based" model. I plan to minimize the amount of time I spend lecturing on course content to allow more time for you to interact with each other and with course content to build understanding. You will be given group activities that will help introduce you to key definitions and theorems. I will give "mini-lectures" on key course content and I will work examples when needed, but the bulk of our time should be spent on in-class activities, discussion, and student presentations.

Instructional Strategies: lecture, group activities, in-class discussions, student presentations, writing assignments, reflective journals, assigned readings, proof portfolios, projects, mastery quizzes.

Attendance and Academic Expectations: Since discussion, in class activities, group work, and proof presentations are all key components of the design of this course, attending class regularly is of paramount importance. I will not directly penalize your grade for absences, but those who miss a group activity will be required to complete an alternate assignment in order to make up for any in-class assignments that they missed. If you are more than a few minutes late to class, I reserve the right to penalize your grade on in-class activities (since your group had to complete a portion of it without you). Just to be clear, each student in the class will be expected to do several in-class presentations of a proof or problem sometime during the semester. This is not optional. Lastly, no one is born knowing how to write good mathematical proofs – it is a learned skill that can be developed and perfected with practice, effort and dedication. By helping one another and maintaining a positive attitude and environment in the classroom, my hope is that each one of you will leave the class more confident in your ability to write mathematics proofs and to engage in mathematical reasoning and problem solving.

Activities: A significant portion of your course grade will be based on successful completion of specific activities designed to help you learn and practice applying concepts from the course. These activities are designed to help you explore and develop an understanding of core course content. My goal is to teach this class using an "inquiry based" approach -- I will spend less time lecturing on course content to allow more time for you to build understanding by interacting with each other and with course content through these activities. "In-Class" activities will may be collected at the end of class, or I may allow you to take them home and bring your completed assignment to our next class meeting.

Writing Assignments: At various times throughout the course, I will assign short, informal writing assignments. Some of these you will complete during class time. Others you will complete outside of class time. We may revisit some of your previous writing later in the course, so you should keep all of your writing in one place.

Homework: I will collect homework for grading approximately once each week. You will be told *at least* one class meeting in advance which problems you are expected to write up. You may need to complete problems in addition to those assigned in order to master course material. You are encouraged to discuss homework with your classmates (and with me) outside of class during my office hours. However, unless an assignment is specifically given as a group assignment, the final product that you submit should represent your own intellectual efforts. If you make significant use of other resources (print, online, classmates, friends, tutors, etc.), you should clearly cite this in your write-up.

Quizzes: I will give quizzes at various times during the course. These quizzes will fall into two categories:

- **In Class Quizzes:** These are short quizzes designed to help you learn and remember key course content – definitions, theorem statements, and "short" problems or proofs. I will usually announce these 1 day in advance, but may surprise you once in a while. These quizzes are worth 5 points each.

- **Mastery Quizzes:** These quizzes will **always** be announced in advance and will be worth 10 points each. Unlike regular quizzes that are only taken once, these quizzes must be re-taken until you attain a score of at least 80% on the quiz. Gateway quizzes will be given in class once. Additional attempts will be proctored **outside of class**.

Presentations: Each of you will be expected to give a few short presentations to your peers during class time. These presentations will involve either presenting the solution to an assigned problem or presenting a proof to your peers. You will be graded on both the accuracy of the mathematical content presented and the clarity and effectiveness of your presentation. These presentations will contribute 25 points toward your final grade.

Projects: There will be several opportunities to do projects during the course. The length, scope, and point value of projects will vary. There should be more than 25 points worth of projects during the course, so you will have some freedom in choosing which projects you would like to work on.

Proof Portfolios: Each class participant will be expected to develop a proof portfolio. This portfolio will consist of samples of mathematical proofs of key types. A proof cannot go into your portfolio until it has been rewritten and revised to both of our satisfaction. At the end of the semester your portfolio will be graded out of 50 points (your grade will be based on how many completed proofs have been added to your portfolio).

Exams: This course will have two exams and a comprehensive final exam, as outlined on the course schedule. Be sure to mark the date of each exam on your calendar, especially the final exam. Each exam (including the final exam) will have two components: an "in-class portion" (this will be closed book, closed notes) and a "take home" portion. Expect more details about these as we get closer to our first exam.

The credit given on exam questions will be based on the amount of correct work shown, or, in the case of proofs, on the completeness, correctness, and clarity of your argument(s). In your final grade, each of the two unit exams will be worth 100 points. The final exam is worth 200 points.

Course Grading Policy: Your final grade in the course will be computed as follows:

Homework/Quizzes/Activities:	170 points
"Proof Portfolio"	50 points
Projects:	25 points
Presentations	25 points
Writing Assignments	30 points
Unit Exams:	200 points
Final Exam:	200 points
Total:	700 points

Final letter grades will be assigned based on the following scale:

97.0-100.0%	A+		82.0-86.9%	B		69.5-71.9%	C–
92.0-96.9%	A		79.5-81.9%	B–		67.0-69.4%	D+
89.5-91.9%	A–		77.0-79.4%	C+		60.0-66.9%	D
87.0-89.4%	B+		72.0-76.9%	C		<60.0%	F

Make-up Work: I will only give make-up assignments for *emergencies* or for absences which are officially sanctioned by the University. I will expect written documentation in either of these cases. If you miss an exam and a make-up exam is not warranted, you may replace your grade on **one** missed exam with your *un-scaled* percentage score on that portion of content on the final exam.

Learning Accommodations: Minnesota State University Moorhead is committed to providing equitable access to learning opportunities for all students and strives to make courses inclusive and accessible in accordance with sections 504 and 508 of the 1973 Rehabilitation Act and the Americans with Disabilities Act. The University will make reasonable accommodations for students with documented disabilities. Accessibility Resources (AR) is the campus office that collaborates with students in need of accommodations and assists in arranging reasonable accommodations.

If you have, or think you may have, a disability (e.g. mental health, attentional, learning, chronic health, sensory or physical), please contact Accessibility Resources at (218) 477-4318 (V), (800) 627.3529 (MRS/TTY), kari.klettke@mnstate.edu or stop by to schedule an appointment with Kari Klettke, Director, in 154C Flora Frick Hall. Please also contact Accessibility Resources if you are currently registered for accommodations and have any questions or concerns. Additional information is available on the AR website: http://www.mnstate.edu/accessibility

Note: If you are registered with the AR and have learning accommodations, please schedule an appointment to visit with me during my office hours to discuss implementation of your accommodation(s).

Academic Honesty: You are expected to do your own work. You may work with others and get help on assignments, but, unless the assignment is specifically designed as a group assignment, all work that you submit must be your own (or should be appropriately referenced). During exams and quizzes you will <u>not</u> be allowed to receive unauthorized help from others. Cheating and plagiarism are not tolerated in any course at any level. See the MSUM Academic Honesty policy for more information on the possible consequences of cheating.

Sexual Violence Policy: Acts of sexual violence are intolerable. MSUM expects all members of the campus community to act in a manner that does not infringe on the rights of others. We are committed to eliminating all acts of sexual violence. MSUM faculty and staff are concerned about the well-being and development of our students. We are obligated to share information with the MSUM Title IX Coordinator in certain situations to help ensure that the students' safety and welfare is being addressed, consistent with the requirements of the law. These disclosures include but are not limited to reports of sexual assault, relationship violence, and stalking.

If you have experienced or know someone who has experienced sexual violence, services and resources are available. You may also choose to file a report. For further information, contact Lynn Peterson, Title IX Coordinator, petrsnly@mnstate.edu; 218-477-2967, or Ashley Atteberry, Director of Student Conduct & Resolution; ashley.atteberry@mnstate.edu, 218-477-2174; both located in Flora Frick 153. Additional information is available at: www.mnstate.edu/titleix

Emergency Preparedness: As we prepare to start a new academic year and semester, the MSUM Facilities, Grounds & Safety Committee would like everyone to review the Emergency maps as well as the Emergency Preparedness Guide. Even a quick look at this information can make a difference in how you may react/respond in an emergency situation. If you have questions after reviewing this information, please contact Jim Schumann, Director of Public Safety for further clarification. Thank you in advance for taking time to help protect yourself and others.

Building maps showing emergency exit routes, fire extinguisher locations, and fire alarm pull stations are conspicuously located in classrooms, labs, conference rooms, departmental main offices and residence halls. The Emergency Preparedness Guides (flip style booklets) are located with the maps.

Please review the floor plans as well as the guide so you know how to respond in an emergency situation to help protect yourself and others.   If you have questions, please contact Ryan Nelson, Director of Public Safety, at ryan.nelson@mnstate.edu or 218.477.5869. or visit https://www.mnstate.edu/publicsafety/

Thanks, And Let's Have a Great Semester!!