Math 401-01 Lie Theory
SPRING 2026

Professor: M. Sandoval, Nutt MECC 219, 297-2062, email: mary.sandoval@mail.trincoll.edu.

Time and Location: MWF 1:30pm–2:45pm, in MECC 293.

Course Website: We should have a Moodle Website in the usual place.

Office Hours:

Monday	11–12:30pm
Wednesday	11–12:30pm
Friday	11am–noon, 1–2pm
or	by appointment.

If making an appointment, please allow at one business day to arrange a mutually agreeable time. Appointments on Tuesdays and Thursdays are generally not available in person, but possibly could take place via zoom, but availability is extremely limited.

About the subject: Lie Theory is a fascinating subject which has deep connections to many areas of mathematics, such as linear algebra, geometry, and group theory. Although it is considered to be an area of abstract mathematics, in recent times, it has been shown to have applications to computer animation and simulation, and computer-assisted manufacturing and design.

This course will introduce you to several different areas of mathematics. You will need a certain amount of mathematical maturity and sophistication to solve problems and write proofs up to be successful in this course.

By the end of this course, successful students will be able to:

1. Students will have a good understanding of number fields, group theory, and some topology.
2. Further develop and practice the skills necessary for mathematical reading and writing–namely, to closely read definitions, arguments, identify common structures, apply abstract criteria to determine if particular examples meet the abstract hypotheses or criteria, and be able to explain the logical relationship between theorems and definitions in this course.
3. Closely read proofs, identify logical structures, and identify commonly used techniques.
4. Reflect on an argument, assess its validity, analyze its structure, comparing it to similarly structured arguments, and revise it as needed.
5. Construct correct, concise arguments (proofs), making well-justified rigorous statements, sometimes from first principles, and write them up clearly, using good style, exposition, and form.

Office Hours: It is quite normal for students to regularly make use of my office hours. In office hours, I will help you learn how to do the homework on your own. I will not do any of the assigned homework problems *for* you. I will gladly review similar problems as examples for you to follow, or review general techniques and strategies. It is your responsibility to see me if you are having difficulty with the homework in a timely manner. Waiting until the last minute is too late. I will distribute solutions to the computational homework once it has been turned in. Please note: you should start the homework soon enough so that you can take advantage of my office hours. If you wait until the last minute to begin the homework, you will not be able to make use of office hours

not skipped problems). You must return your rewritten work within one week of the time it was handed back, whether you were present in class that day or not.

Submitting Your Work: All of your will be submitted via moodle via scanned pdf files.

Presentations: Each week, you will present some homework problems to the group. There is a rubric posted with the course documents.

Class Participation: In a reading/seminar course like this one, class participation is critically important. It is expected that you will attend all classes and participate in discussions. In addition, you are expected to pay careful attention to the presentations of others, and to ask questions and offer comments. I may ask you to answer some questions in the form of a quiz or to answer verbally some discussion questions on the reading, assignments, or presentations, as part of this grade.

Academic Honesty: Academic honesty is highly valued at Trinity. The College policies on intellectual honesty are found in the Student Handbook, in addition to which I may add specific instructions for specific assignments, which I will give to you in writing. If in any doubt, do not fail to contact me by phone or email to clarify any question **before** an assignment is submitted. In general, it is always wise to avoid even the *appearance* of academic dishonesty. Unhappily, cases of academic dishonesty are all too common and are vigorously prosecuted.

Math 401 Lie Theory
Rubric for Proofs

This document is designed for ensure that you, the student, have a clear understanding of how your proofs will be graded. You should read the documents in the Proof-Writing Resources folder for more information about what is expected in a proof.

Proofs will be graded out of 10 points. When grading a proof, I look for a sound argument that is clear, concise, and flows well when read aloud. Presentation will be graded–sloppy writing will receive penalties. (If you have bad handwriting, you will be required to use a word-processing program to write your proofs. Most word processing programs have equation editors capable of handling anything you might be expected to show in this class.) However, in order to be eligible to have your proof graded, it must meet some minimum criteria. See below.

Basic Requirements for Proofs: Each proof must meet the following minimum requirements. Any proof that does not meet these basic requirements will not be considered for grading, and will be returned with a zero grade.

1. The entire statement problem must be included, written out in its entirety, word for word, as it appears in the assignment. If a problem refers to something in the text, you should write out the relevant information from the text.

2. The first sentence of your proof must identify the basic strategy of the proof. How will you go about accomplishing the task? Minimally, this might include a sentence identifying the type of proof. Direct proof? Proof by direct abstract computation? Proof by induction? Disproof by counterexample? Contrapositive proof? Proof by Contradiction? You may want to review the basic proof types that you learned in a previous course. You may also wish to expand upon this by stating your plan more precisely.

3. The second paragraph of your proof must contain all the assumptions that you are making, and establish the notation that you are using.

A proof that meets these basic criteria will receive at least one point. Otherwise, numerical assignments of grades will be made as follows:

10 points No flaws; the proof is cleanly and clearly written with adequate spacing.

8–9 points One or two minor flaws

6–7 points One major flaw or several minor flaws

5 points A major flaw and a minor flaw, but the basic plan of the proof is there and is largely carried out correctly.

4 points Multiple major flaws.

3 points Multiple major flaws and minor flaws, but a few correct steps.

Rubric for Proofs			
Content			
Poor/unsatisfactory	**Developing**	**Adequate**	**Excellent**
One or more hypotheses are neglected/not used or mentioned.	Hypotheses are not explicitly analyzed.	The hypotheses have been fully used, andtheir uses explained in the argument, at least implicitly.	The hypotheses have been fully used, and fully explained in the argument.
One or more definitions are not explicitly used. Understanding of one or more definitions is not demonstrated.	Most definitions are used but are not explicitly analyzed. Only some understanding is demonstrated.	Definitions have been clearly stated, and used in the argument in at least implicitly.	All definitions have been clearly stated, and used in the argument in an explicit way.
All or most quantifiers are neglected.	Quantifier errors are present and affect meaning.	Quantifier errors are occasional and do not seriously affect meaning.	Quantifiers have been approriately used.
Argument is vague, cannot be followed, or is missing. Or there are giant gaps in reasoning.Irrelevant and/or incorrect statements are present.	Argument is hard to follow or muddy. The reader must infer missing steps to make sense of what is going on. Incorrect statements are made, but are not crucial to the argument. Key statements are missing or unjustified.	Argument is clear. All key statements are correct, and justified, perhaps by re-proving known results. All uses of theorems and definitions are explicit and are appropriately cited. Irrelevant but correct statements may be present.	Argument is clear and concise. All key statements are necessary to the argument, correct, and fully justified, by appealing to prior known results. All uses of theorems and definitions are explicit and are appropriately cited.

Structure and Organization			
Poor/unsatisfactory	**Developing**	**Adequate**	**Excellent**
Proof begins by assuming the conclusion.	Proof does not identify the goal.	Proof analyzes what needs to demonstrated if the goal is not obvious.	Proof analyzes what needs to demonstrated and expresses the idea clearly.
One or more equality is assumed.	Proof involves a backwards calculation, where an equality is posited, and then calculations are performed on both sides of the posited equality.	Calculations are performed without inappropriate assumptions. Assumptions of equality are not made without having been demonstrated.	Calculations are performed starting with a true statement and proceed in a "forward" direction. Assumptions of equality are not made without having been demonstrated.
Cases or parts of the proof are missing or not explicitly stated.	The proof is broken down into cases or parts, but these parts are not clearly identified or made explicit.	All parts of the proof are clearly identified.	All parts of the proof are clearly identified with prose. The logical structure of the proof is clearly explained.
Demonstrates a lack of understanding of the logical structure of what is being asked.	Understanding the of the logical structure of what is required seems to be understood but is not explicit and must be inferred by the reader.	Understanding the of the logical structure of what is required is clearly stated or otherwise demonstrated.	Understanding the of the logical structure of what is required is clearly stated or otherwise demonstrated using grammatical English exposition.

RUBRIC FOR MATHEMATICAL PRESENTATIONS

	UNSATISFACTORY	BASIC	PROFICIENT	DISTINGUISHED
Mathematical Concepts	Displays errors in knowledge of mathematical concepts.	Explains mathematical concepts without difficulty, but expresses ideas in rudimentary form.	Clearly articulates mathematical concepts.	Fully and eloquently articulates mathematical concepts. Develops connections among mathematical concepts.
Mathematical Procedures	Has difficulty explaining mathematical procedures.	Explains mathematical procedures without difficulty.	Explains mathematical procedures without difficulty and provides partial explanations for why mathematical procedures are valid or appropriate.	Explains mathematical procedures without difficulty and provides full explanations for why mathematical procedures are valid or appropriate.
Examples	No examples or inappropriate examples.	Adequate choice of examples; may contain minor flaws.	Appropriate choice of examples.	Well-chosen and well-sequenced examples.
Mathematical Representations (equations, diagrams, graphs, tables, etc.)	Representations are inappropriate or unclear.	Representations clear and appropriate, but no connections are made between representations.	Representations are clear and appropriate, with explanations of significant elements. Mentions connections among representations.	Representations are clear and appropriate, with explanations of significant elements. Clearly explains connections among mathematical representations.
Mathematical Communication	Consistently inappropriate use of mathematical terminology and/or symbols.	Adequate use of mathematical terminology and symbols; may contain minor flaws.	Appropriate use of mathematical terminology and symbols.	Sophisticated use of mathematical terminology and symbols.
Presentation Structure	The presentation has no clearly defined structure, or the structure is chaotic.	The presentation has a recognizable structure with an introduction and conclusion.	The presentation has a clearly defined structure with some clear transitions and a logical introduction and conclusion.	The presentation has a clearly defined structure with elegant transitions and an effective introduction and conclusion.
Written Communication	Writing is illegible or not adequately used to record information.	Writing is legible and grammatically correct.	Writing is legible and well-organized.	Communicates clearly and effectively. Legible and grammatically correct.
Oral Communication	Does not speak clearly or demonstrates consistent grammatical errors.	Speaks clearly with no grammatical errors.	Speaks clearly and effectively.	Speaks clearly and effectively in a sophisticated manner.