MA 434	**Topics in Algebra**	**Spring 2018**
	TR 1 - 2:15	**Davis 217**

Professor:	Scott Taylor
Office Hours:	Mon. & Wed. 12 - 2:30
	Tues. & Thurs. 11 - 12
	Fri 12 - 1.
	and by appointment!
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Webpage:	`http://www.colby.edu/~sataylor`
Course Blog:	`http://web.colby.edu/thegeometricviewpoint/`
Prerequisites:	MA 333 or permission of instructor
Text:	John Meier *Groups, Graphs, and Trees*

The Course:

Geometric Group Theory (GGT) is a relatively new mathematical discipline which has had significant impact on the much older disciplines of geometry, topology, and algebra. In recent years, major open problems have been solved using GGT methods. Plus, it's a beautiful subject! There are pretty pictures, elegant examples, clever theorems, and significant new ways of looking at classical objects (such as graphs and groups.)

Roughly speaking, GGT uses geometric and topological methods to study (usually infinite) groups and uses algebraic methods to study geometric and topological spaces. This merger of different mathematical disciplines makes GGT a perfect topic for a major capstone course.

And this is a capstone course for your major! So you should plan to take significant responsibility for your education - lots of self-teaching and student presentations. This is where you put into practice many (if not all) of the ideas, methods, and habits of thought you've learned over the years as a Colby math major. But don't get stressed out - I'm here to help. I'll provide guidance on the readings and hints on the problem sets, as needed. It should be fun.

Objectives for increasing mathematical maturity:

- Combine informal and formal reasoning to draw significant inferences about infinite groups from a geometric perspective.
- Engage in significant self-teaching of mathematics.
- Effectively communicate mathematics in both professional and informal styles.
- Effectively work with others on mathematical projects.

Major Course Content Objectives

- Understand actions of groups on sets and metric spaces (esp. graphs)
- Be able to state and prove the Sylow theorems.
- Be able to construct Cayley graphs for a given group with generating set.
- Be able to deduce algebraic properties of a group from certain generating sets.
- Be able to define and construct free groups, free products of groups, Coxeter groups, lamplighter groups, and Baumslag-Solitar groups.

- Be able to read a research paper in GGT and explain most of its contents to your classmates and write a summary for the mathematically educated public.

Academic Honesty: Honesty, integrity, and personal responsibility are cornerstones of a Colby education and provide the foundation for scholarly inquiry, intellectual discourse, and an open and welcoming campus community. These values are articulated in the Colby Affirmation and are central to this course. You are expected to demonstrate academic honesty in all aspects of this course. If you are clear about course expectations, give credit to those whose work you rely on, and submit your best work, you are highly unlikely to commit an act of academic dishonesty.

Academic dishonesty includes, but is not limited to: violating clearly stated rules for taking an exam or completing homework; plagiarism (including material from sources without a citation and quotation marks around any borrowed words); claiming anotherÕs work or a modification of anotherÕs work as oneÕs own; buying or attempting to buy papers or projects for a course; fabricating information or citations; knowingly assisting others in acts of academic dishonesty; misrepresentations to faculty within the context of a course; and submitting the same work, including an essay that you wrote, in more than one course without the permission of the instructors.

Academic dishonesty is a serious offense against the college. Sanctions for academic dishonesty are assigned by an academic review board and may include failure on the assignment, failure in the course, or suspension or expulsion from the College. For more on recognizing and avoiding plagiarism, see the library guide: libguides.colby.edu/avoidingplagiarism

Using the internet: The point of taking a course is to learn everything you can. Making excessive or inappropriate use of the internet prevents you from learning, damages my trust in you, and is discouraging to classmates who put forth their best efforts. In this course, you are permitted (though not encouraged) to make use of online resources which explain graph theory concepts, but not online resources which contain solutions to particular problems on homework or exams. In particular, you are not permitted to post course problems to websites (such as math.stackexchange or chegg.com) to solicit help from the denizens of the internet and you are not permitted to use solutions provided by such sites. In any case, many answers on such sites are incorrect - so you will waste time you could spend in office hours or thinking about the problem for yourself! I would much rather you turn in a “solution” which is a discussion of all the things you tried and which didn’t work than see a solution copied from the solutions manual. **In any case, any time you refer to any source - print or online - other than the course text, notes, or office hours, you are expected to cite your source.**

The Colby Affirmation

Colby College is a community dedicated to learning and committed to the growth and well-being of all its members.

As a community devoted to intellectual growth, we value academic integrity. We agree to take ownership of our academic work, to submit only work that is our own, to fully acknowledge the research and ideas of others in our work, and to abide by the instructions and regulations governing academic work established by the faculty. As a community built on respect for ourselves, each other, and our physical environment, we recognize the diversity of people that have gathered here and that genuine inclusivity requires active, honest, and compassionate engagement with one another. We agree to respect each other, to honor community expectations, and to comply with college policies.

As a member of this community, I pledge to hold myself and others accountable to these values.

What does this mean to students?

(1) We respect each other and ourselves.
(2) We respect our physical spaces on campus.
(3) We respect our academics and complete work honestly.

Evaluation: The numerical course grade will be a weighted average of the cumulative grades with weightings as follows:

25 %	class attendance and participation
25 %	in-class group projects
15 %	problem sets and reading assignments
20 %	Midterm Exam
15 %	Final Project and presentation

Course letter grades will be assigned (subject to the above caveat) according to the following scale. Any curve will be determined at the end of the course according to the discretion of the instructor. An A+ may be awarded to students who do exceptionally well and who demonstrate an exceptional interest in the course.

93 – 100 %	A	90 – 93 %	A-	87 – 90 %	B+	83 – 87%	B
80 – 83 %	B-	77 – 80 %	C+	73 – 77 %	C	70 – 73%	C-
67 – 70 %	D+	63 – 67 %	D	60 – 63 %	D-	below 60%	F

Structure and Schedule:

The first two weeks of class will be devoted to standard advanced algebra material (Sylow theorems and group actions). Class periods will mostly be occupied with working on guided explorations in pairs, but there will be some discussion.

After the first two weeks, we will begin using our textbook[1] (which you should bring to class everyday). Most every Tuesday will be a combination of student presentations, group work, and a small amount of lecture. Problem sets are generally collected on Tuesdays. You will know a week before you present. You should expect to present several times over the course of the semester. Thursdays will have more lecture but will also include some group work. Usually on Tuesdays you will have reading assigned which will be due on Thursday, as well as the weekly problem set due the following Tuesday.

The midterm exam will be in class on **March 22** (the Thursday before spring break).

The end of the semester will be devoted to small group projects. Each project will result in a blog post (to the course blog) and a presentation during the final exam block. The final exam block is 6 - 9 PM on **Friday, May 18**.

Attendance and Participation: I value your involvement in the class, therefore class attendance is mandatory. Absence for official Colby activities requires prior approval. I expect you to be present and fully engaged in each meeting of the class. However, if you need to miss class for religious or health reasons, please just be in communication with me. Active participation means that you are "on-task" during small group projects, that you are prepared and practiced for your presentations, and that you ask and answer questions. It also means that you treat your classmates with respect, generosity, and encouragement.

Colloquium: You are encouraged to attend the departmental colloquium whenever it occurs (typically Mondays at 4 PM). *But, you must attend two Mathematics/Statistics Colloquiua.* For each you need to

[1] If you will have financial difficulties in purchasing the text, please speak to your advising dean.

write a page summarizing and reacting to the lecture. Attending colloquia helps you develop your own presentation skills and exposes you to the larger context of mathematical endeavors.

Problem Sets and Reading Assignments:

Homework is where you wrestle with new ideas, generate creative solutions, and convey your thoughts to others. You will spend significant time reading the course text *slowly* and answering reading comprehension questions. You will also spend significant time working on writing proofs. You are expected to write complete, careful, and correct proofs. You should start the homework early, some problems will require multiple attempts and careful thought. If you are having substantial difficulty with a particular problem or the entire homework set, you should email me or come to office hours. I am eager to help you! You are encouraged to work with a partner on the homework, but all work should be your own. In other words, you may discuss particular problems but you may not copy someone else's solution. Doing so is an act of academic dishonesty.

Late homework may be penalized. Start HW early! Homework problems will be thoroughly graded for both mathematical correctness and completeness and clarity of the proof. If you rely on or consult *any* outside sources (on the internet or in print) you must cite them on your homework. You may not post course questions or minor modifications of them to the internet to solicit help from the online community. Instead, you should email me or come to my office.

Because there will be a lot of paper being passed back and forth between us, you must follow these guidelines for homework:

- Each assignment must have your full name, the date it is due, and the assignment number on each page of the assignment.
- Problems must be turned in in the order they are assigned.
- All solutions must be turned in on 3-hole punched paper and placed into the "official" homework binder.
- Each proof must be written on its own 2-sided sheet of paper. You are encouraged not to turn in your first draft of any of these problems.
- Rewrites must be turned in with the original solution. No credit will be given for rewrites without the original attached. It must be clear exactly which problems from which assignments are being rewritten.
- Homework must be very neat. This means: no messy scratchwork, no cramped writing, no huge eraser marks. If these guidelines are not followed you may be penalized. If you are incapable of writing neatly, you should type your solutions. LaTeX is the most popular mathematical typesetting software, but you may also use software like *Scientific Word* or *Mathematica*. There are resources for learning LaTeX on my webpage.

Proof Expectations: It is expected that every graded proof be written in conventional mathematical style. Each statement should follow logically and naturally from the previous ones. It is possible for a proof to be substantially correct but not to receive full credit because the writing was not up to standard. The audience you should keep in mind is an imaginary classmate who is not quite as "bright" as yourself. The danger in communicating mathematics is always assuming your audience knows more than they do! This being graph theory, good illustrations can help you communicate the important ideas in a proof. Be careful, however, that you do not rely on pictures to the detriment of logic. Always ask yourself if there are other possible pictures and if your argument relies too heavily on the particular picture you have drawn.

Final Project and Presentation:

Final projects/presentations will be in small groups. You will read a research paper in geometric group theory (or related discipline) and summarize its findings and arguments, perhaps with illuminating examples.