

Course Outline for MATH 4981, Advanced Topics in Mathematics

MATH 4981 Advanced Topics in Mathematics (3 units)

Prerequisite: Graduate standing in Mathematics, MATH 306, or [MATH 3152](#); and consent of instructor.

Exploration of advanced topics and problems in mathematics. The Class Schedule will list subtitle selected. Repeatable up to 6 units. 3 lectures. Formerly MATH 475.

Course Learning Objectives	
1	Solve problems in current areas of mathematical research.
2	Develop rigorous proofs of mathematical statements from advanced fields of mathematics.
3	Analyze open-ended problems in mathematics.
4	Develop and evaluate potential research projects.

Expanded Course Content

Textbooks, materials, and/or other resources
The textbooks will be determined by the instructor and will depend on the topic selected.
An example is given below on the topic of Geometric Group Theory using the book: Groups, Graphs and Trees, by John Meier.

Week	Readings	Topics of Discussion
1	Chapter 1	Cayley's Theorem, graphs, symmetry groups of graphs, orbits and stabilizers
2	Chapter 1	Generating sets and Cayley graphs, fundamental domains and generating sets, words and paths
3	Chapter 3	Free groups, free group homomorphisms and group presentations, free groups and actions on trees
4	Chapter 3	Free products of groups, free products of finite groups are virtually free

Week	Readings	Topics of Discussion
5	Chapter 3	Finite groups acting on trees, Serre's property FA and infinite groups
6	Chapter 5	Normal forms, Dehn's word problem
7	Chapter 5	The word problem and Cayley graphs, the Cayley graph of $BS(1,2)$
8	Examples of Groups (Chapters 2, 4, 6)	Groups generated by reflections, Baumslag-Solitar groups, a finitely generated infinite torsion group
9	Chapter 7	Regular languages and automata, a return to normal forms
10	Chapter 7	Finitely generated subgroups of free groups
11	Chapter 9	Geometry of infinite groups, the word metric, the growth of groups I, growth and regular languages
12	Chapter 9	Growth and regular languages Cannon pairs, Cannon's almost convexity
13	Examples of Groups (Chapters 8, 10)	The Lamplighter group, Thompson's group
14	Chapter 11	Large scale geometry of groups, changing generators, the growth of groups II, the growth of Thompson's group
15	Chapter 11	Ends of groups, the Freudental-Hopf Theorem, two-ended groups, commensurable groups and quasi-isometry

Method of Assessment

The possible methods of assessment are written individual examinations, quizzes, in-class worksheets and presentations, projects, and homework. One or more midterms and a cumulative final exam are required.

Instructional Mode

The instructional mode for this class is face-to-face. This designation means that the essential academic standards of the course require in-class student engagement, and thus remote instruction is not appropriate.