

Course Outline for MATH 5204, Algebra

MATH 5204 Algebra (3 units)

Prerequisite: Completion of the Graduate Written Exam in Algebra.

Action of a group on a set, semi-direct products, solvable groups, p-groups, Sylow theorems, classification of groups of small order, group presentations, finitely generated abelian groups, matrix groups, and advanced concepts. 3 lectures.

Course Learning Objectives	
1	Identify and prove results about common finite groups and matrix groups.
2	Classify the G-sets of a finite group.
3	Prove all finite p-groups are solvable.
4	Prove theorems about simple groups.
5	Compute the subgroup tree of a finite group via group actions.
6	Use the Sylow theorems and semi direct products to classify groups of small order.
7	Calculate the invariants of a finitely generated abelian group from a group presentation.

Expanded Course Content

Textbooks, materials, and/or other resources
Instructors can choose from a variety of textbooks and/or additional readings; often more than one text will be required. (There is free access to digital editions for many appropriate texts via the CP library). Possible textbooks include: 1. Dummit & Foote, Abstract Algebra, 3rd Edition 2. M. Artin, Algebra, 2nd Edition 3. T. Hungerford, Algebra, 8th Editio 4. K. Tapp, Matrix Groups for Undergraduates, 2nd Edition The sample course outline below is based on Dummit & Foote, Artin, and Hungerford.

Week	Readings	Topics of Discussion
1	D&F 4.1	Action of groups on sets, basic examples, orbit-coset correspondence theorem and conjugate stabilizers theorem.
2	Artin 6.12	Application: The rotation groups of the Platonic solids.
3	D&F 2.2	Centralizer and normalizer subgroups; conjugation in S_n and A_n .
4	D&F 4.1, 4.2, 4.3	Left regular action and Cayley's theorem and adjoint actions; class equation, simplicity of A_5 .
5	D&F 4.3 (continued), 5.5	Category of G-Sets; semi direct products.
6	D&F 3.4, 6.1	P-groups, solvable groups, Cauchy's theorem.
7	D&F 4.5	Sylow theorems.
8	D&F 5.3, 6.2	Applications to classification of finite groups.
9	Hungerford, Chapter VII, Section 2 Appendix	Calculation of invariants from group presentations for finitely generated abelian groups.
10	Artin 9.1	General and special linear groups, orthogonal groups, and unitary groups.
11	Artin 9.2, 9.3, 9.4	The 3-sphere and the special unitary group $SU(2)$; the rotation group $SO(3)$.
12	TBD by instructor Sample: Artin 5.4, 9.5	Instructor's Choice Sample choice: The exponential map, one-parameter subgroups.
13	TBD by instructor Sample: Artin 9.6	Instructor's Choice Sample choice: The Lie algebra
14	TBD by instructor Sample: Artin 10.1	Instructor's Choice Sample choice: Introduction to group representations
15	TBD by instructor Sample: Artin 10.2	Instructor's Choice Sample choice: Irreducible representations and Maschke's Theorem

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.