# ALGEBRA I - MATH 5590H AND 5111

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## Course Information

**Homepage.** https://people.math.osu.edu/gautam.42/A18/algebra.html

**Class time and place.** MWF 11.30AM-12.25PM. Cockins 218.

**Recitations.** TR 11.30AM-12.25PM. Caldwell 177.

**Textbook.** D.S. Dummit and R.M. Foote, *Abstract Algebra*, $3^{rd}$ edition.

**Contents.**

- *Group Theory.* Definitions, examples, basic properties. Subgroups, cosets, Lagrange's theorem. Group homomorphisms. Normal subgroups. Isomorphism theorems. (Semi)direct product of groups. Group actions, orbits and stabilizers, counting lemmas. The group of automorphisms. Sylow theorems. Finitely generated abelian groups. Compositions series. Nilpotent and solvable groups.

- *Ring Theory.* basic definitions of rings, ideals, homomorphisms, isomorphism theorems. Prime ideals and maximal ideals. Nilradical, primary ideals. Rings of fractions. Chinese remainder theorem. Prime and irreducible elements, PID, UFD, Euclidean domans. Quadratic integer rings.

- *Polynomials.* Polynomial rings. Irreducibility criteria, symmetric polynomials, discriminant.

**Grading.** Your overall grade will be determined by:

- *Homework* 15%. Homework will be assigned (almost) each week from the textbook. I will suggest a list of problems for practice and specify 4-6 problems from the list, whose solutions you will have to submit for grading.

**Please see course schedule on page 3 for the dates of quizzes and exams.**

- *Quizzes* 10%. There will be 6 short quizzes during the semester.

- *Midterms* 45%. We will have three in-class midterm exams, each worth 15% of your final grade.

- *Final exam* 30%.

**Further readings.** You are encouraged to read about (and present) some interesting topic/problem related to our course. There are a few slots in the course schedule, on page 3, left intentionally for such a discussion session. A list of suggested topics will be made available at:

https://people.math.osu.edu/gautam.42/A18/topics.html

**Lecture notes.** I will upload my notes, periodically, at the following link. So, in case you miss a class (**not recommended**) you can download the notes.

https://people.math.osu.edu/gautam.42/A18/notes.html

**A word about the class style.** I will occasionally assign reading topics in the class, so that you can have sufficient time to think about it and have questions ready. Many of the lectures will be devoted to open discussions and problem sessions, which will be more beneficial if you have already done the reading assignment.

**A word about the calendar on page 3.** The schedule sketched here is flexible. I have left enough room for discussions, further topics and student presentations. Of course, such things depend very senstively on how the class is progressing. I will try to keep it up to date, and make the most recent version availablet at:

https://people.math.osu.edu/gautam.42/A18/syllabus.pdf

## General Policies

**Academic Misconduct.** It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct (http://studentaffairs.osu.edu/info_for_students/csc.asp).

**Disability Services.** Students with disabilities that have been certified by the Office for Disability Services will be appropriately accommodated and should inform the instructor as soon as possible of their needs. The Office for Disability Services is located in 150 Pomerene Hall, 1760 Neil Avenue; telephone 292-3307, TDD 292-0901; http://www.ods.ohio-state.edu/

## Course Schedule

The following schedule is tentative only. You will be notified of any changes by email, or in class. The most recent version of this syllabus will remain available at
https://people.math.osu.edu/gautam.42/A18/syllabus.pdf

| Week | Topics | Sections | HW/Quiz |
|---|---|---|---|
| **1** 8/21-24 | Definitions and examples. Subgroups, order, generators. Presentation of a group. Cyclic groups. Free groups. | 1.1–1.5, 6.3 2.1–2.4 | HW 1 due on 8/31 |
| **2** 8/27-31 | Cosets, index, normal subgroups, quotient groups. Group homomorphisms. Isomorphism theorems. | 1.6, 3.1–3.3 2.5 | HW2 due on 9/7 Q1 on 8/27 M |
| September 3 - Labor day, no class | | | |
| **3** 9/4-7 | Group actions. Counting lemmas. Group acting on itself. Conjugacy classes, p-groups, Sylow theorems | 1.7, 4.1–4.3 4.5 | HW3 due on 9/14 Q2 on 9/7 F |
| **4** 9/10-14 | Sylow theorems - applications. Simple groups. Symmetric and alternating group. | 3.5, 4.4, 4.5 6.1 | No homework No quiz |
| **Mid term 1 on Tuesday 9/18** | | | |
| **5** 9/17-21 | Review. Finitely generated abelian groups. Group of automorphisms. Semidirect products. | 3.5, 4.4, 4.6 5.1–5.5 | HW 4 due on 9/28 |
| **6** 9/24-28 | Composition series. Jordan-Hölder theorem. Solvable groups. | 3.4, 6.1 | HW5 due on 10/5 |
| **7** 10/1-5 | Commutators. Nilpotent groups. Central series *Room for student presentations* | 6.1 | Q3 on 10/1 M |
| **8** 10/8-10 | Problem session/review. | | |
| **Mid term 2 on Wednesday 10/10** | | | |
| Autumn break - Oct. 11,12, no class. | | | |
| **9** 10/15-19 | Ring theory, definitions, examples. Ring homomorphisms. Isomorphism theorems. Integral domains. Characteristic. | 7.1–7.4 | HW6 due on 10/26 |
| **10** 10/22-26 | Prime and maximal ideals. Rings of fractions. Localization | 7.4–7.6 15.4 | HW7 due on 11/2 Q4 on 10/24 W |
| **11** 10/29-11/2 | Nilradical, Jacobson radical. Noetherian rings Hilbert Basis theorem. Primary decomposition. | 15.1, 15.2 9.1, 9.2 | Q5 on 11/2 F |
| **12** 11/5-9 | Euclidean domains, PID and UFD. Gauss' lemma. Eisenstein criterion for irreducibility. | 8.1-8.3 9.2, 9.3 | HW8 due on 11/16 |
| November 12 - Veteran's day, no class | | | |
| **13** 11/13-16 | Polynomials cntd. Several variables. Gröbner basis. | 9.4-9.6 | HW 9 due on 11/30 Q6 on 11/16 F |
| **14** 11/19,20 | Review. | | |
| **Mid term 3 on Tuesday November 20** | | | |
| November 21-23, Thanksgiving break, no class | | | |
| **15** 11/26-30 | Presentations | | |
| **16** 12/3-5 | Review | | |
| **Final exam: Thursday 12/13. 10-11.45AM. Location TBD.** | | | |