SYLLABUS

MTH 331 &H – Introduction to Abstract Algebra I – Fall 2021

Instructor: Dr. Sofya Chepushtanova

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Class Meetings: MWF 11:00-11:50 am and T 03:00-03:50 pm, SLC 359.

Office Hours: TF 10:00-10:50 am, MWF 12:00-12:50 PM, or by appointment.

What is Abstract Algebra? Algebra is defined to be the study of algebraic structures. Mathematicians study algebraic structures from a general point of view, compare different structures, and find relationships between them. In this course we will study elementary number theory, groups, rings, and fields.

Prerequisites: MTH 302 or an equivalent course (or consent of the instructor). Students are expected to understand and apply various methods of proofs (*e.g.*, direct proof, proofs by contrapositive and contradiction, induction, etc.) and be comfortable working with concepts and results related to elementary set theory (*e.g.*, union, intersection, complement, etc.)

Textbook: Tom W. Judson's *Abstract Algebra: Theory and Applications*, freely available online: http://abstract.ups.edu/index.html.

Other Useful References:

1. Joseph Gallian, *Contemporary Abstract Algebra*, 8th Ed., CENGAGE Learning
2. Charles Pinter, *A Book of Abstract Algebra*, 2nd Ed., Dover
3. William Gilbert and W. Keith Nicholson, *Modern Algebra with Applications*, 2nd Ed., A John Wiley & Sons

Course Objectives: Upon completion of this course,

1. Students will demonstrate factual knowledge including the mathematical notation and terminology used in this course. Students will read, interpret, and use the vocabulary, symbolism, and basic definitions used in abstract algebra, including binary operations, relations, groups, subgroups, homomorphisms, rings, and ideals.
2. Students will describe the fundamental principles including the laws and theorems arising from the concepts covered in this course. Students will develop and apply the fundamental properties of abstract algebraic structures, their substructures, their quotient structure, and their mappings. Students will also prove basic theorems such as Lagrange's theorem, Cayley's theorem, and the fundamental theorems for groups and rings.
3. Students will apply course material along with techniques and procedures covered in this course to solve problems. Students will use the facts, formulas, and techniques learned in this course

to prove theorems about the structure, size, and nature of groups, subgroups, quotient groups, rings, subrings, ideals, quotient rings, and the associated mappings. Students will also solve problems about the size and composition of subgroups and quotient groups; the orders of elements; isomorphic groups and rings; and the composition of ideals.

4. Students will develop specific skills, competencies and thought processes sufficient to support further study or work in this or related fields. Students will acquire a level of proficiency in the fundamental concepts and applications necessary for further study, including graduate work, in academic areas requiring abstract algebra as a prerequisite, or for work in occupational fields requiring a background in abstract algebra or other highly abstract mathematics. These fields might include the physical sciences and engineering as well as mathematics.

Attendance: You are expected to attend classes regularly. *Remember that poor attendance is a major contributor to poor performance!* If you miss a class, it is your responsibility to obtain notes from a classmate, find out any announcements made during the class, and make sure your homework turned in on time. After five or more unexcused absences from a class, students may be readmitted to the class only by action of the Office of Student Affairs and the department chairperson concerned; this may also result in failure of the course, unless there are extenuating circumstances.

COVID-19 Safety Rules: *Always wear a mask. Wash your hands or use hand sanitizer. You may want to sanitize your desk before class. Use the same seat in the classroom (for contact tracing purposes). No eating or drinking allowed in the classroom (bottled water only). If you are sick, stay at home, and let the instructors and student health services know.*

Homework: Homework problems will be assigned weekly. Start working on assigned problems as soon as the corresponding sections are covered. *It is a fact that doing problems is the way to learn mathematics.* You may discuss homework problems with me or your classmates, but I insist that everybody writes up their own solutuions demonstrating understanding. Problem sets will be due at the beginning of class.

For the honors component of the homework grade, students are required to submit one to three extra problems of advanced level weekly, in addition to each common homework assignment. All homework will count 10% toward the final grade, including the honors component that contributes 2% to this part.

Write your homework solutions neatly and legibly on 8.5" x 11" paper. You are also encouraged to type your solutions using TEXor LATEX, the standard in mathematical typesetting. There are versions available for you to use in the department labs. See our course webpage for tutorial and example links.

Presentation: For the honors component of the final grade, students will work on an advanced topic and deliver a 25 to 50 minute presentation at the end of the semester. This will count 5% toward the final grade.

Exams: There will be three in-class one-hour examinations and a comprehensive final examination. Make-up examinations will not be allowed except for extreme circumstances. It is the students responsibility to contact the instructor if an emergency situation occurs. Notice of the emergency should be made in a timely fashion and proper documentation will be required.

Midterm exams together will count 55% toward the final grade, including advanced problems for

honors students contributing 5% to this part. Honors students' final examination will consist of two parts: written and oral. The written part has additional advanced problems, while the oral part is a discussion (with the instructor) of particular problems' solutions from the final examination. The final examination will count 30% of the final grade, with advanced problems and oral part each contributing 5% to the final examination grade.

Grade Distribution: Final score in this course will be calculated as follows:
Homework 10% + Presentation 5% + Best Exam 22% + Median Exam 18% + Worst Exam 15% + Final Exam 30% = 100%.

The final grade will be computed from the total percentage earned as follows:

Percentage	*Grade*
90 – 100%	4.0
85 – 89%	3.5
80 – 84%	3.0
75 – 79%	2.5
70 – 74%	2.0
65 – 69%	1.5
60 – 64%	1.0
< 60%	0.0

Drop Policy: If you wish to drop from the course, I will give my permission during the first ten weeks of the semester. Thereafter you will need the permission of the Dean. Be aware that poor performance in the course will not be a sufficient reason for the Dean's permission to be granted.

Academic Honesty: By handing in homework, quizzes, and exams you certify that this is your own work. You are encouraged to discuss homework solution strategies with fellow students but the final write-up must be your own. A violation will result in a grade of zero on that particular assignment; serious or repeated infractions of the Academic Honesty policy will result in failure of the course.

Cell Phones should be switched to silent mode (or turned off), and put out of sight during class time. **NOTE: THE USE OF CELL PHONES DURING EXAMS IS EXPRESSLY FORBIDDEN AND WILL RESULT IN A GRADE OF 0.**

Email Etiquette: Please refer to the following tutorial on how to communicate with your instructor via email: `https://www.math.uh.edu/~tomforde/Email-Etiquette.html`. View an email to a professor as a professional interaction. How you choose to interact conveys your level of seriousness and professionalism.

Tentative Class Schedule Fall 2021

1. Week of 8/30: Introduction. Preliminaries: summary on proofs, set theory overview (Ch. 1). Integers: principle of well-ordering, division algorithm, Euclidean algorithm, prime numbers, Fundamental theorem of arithmetic (Ch. 2).

2. Week of 9/6: *No class on Monday - Labor Day.* More on integers (Ch. 2).
   Integer equivalence classes and symmetries. The integers mod n, modular arithmetic. Definitions, properties, and examples of groups and subgroups (e.g., abelian and permutation groups) (Ch. 3).

3. Week of 9/13: More on groups (Ch. 3).

4. Week of 9/20: Cyclic groups (Ch. 4). **Exam I** on Chapters 1-4.

5. Week of 9/27: Permutation groups (Ch. 5). Cosets and Lagrange's Theorem (Ch. 6).

6. Week of 10/4: More on cosets and Lagrange's Theorem (Ch. 6). Isomorphisms (Ch. 9).

7. Week of 10/11: More on isomorphisms (Ch. 9). Normal subgroups and factor (or quotient) groups (Ch. 10). *No class on Friday - Fall Recess.*

8. Week of 10/18: More on normal subgroups and factor groups (Ch. 10). **Exam II** on Chapters 5, 6, 9, 10.

9. Week of 10/25: Homomorphisms (Ch. 11).

10. Week of 11/1: On the structure of groups (Ch. 13 partially). Rings (Ch. 16).

11. Week of 11/8: More on rings (Ch. 16).

12. Week of 11/15: Polynomials (Ch. 17). **Exam III** on Chapters 11, 13, 16, 17.

13. Week of 11/22: Integral domains (part of Ch. 18). *No classes Wednesday through Friday - Thanksgiving Recess. Tuesday follows Thursday schedule.*

14. Week of 11/29: Vector spaces (Ch 20) - *if time permits.* Fields (Ch. 21).

15. Week of 12/6: More on fields (Ch. 21). **Student presentations.**

16. Week of 12/13: **Student presentations.** *Monday (last day of class) follows Friday schedule.* **Final Examination: TBA.**