

Math 341-01, Abstract Algebra, Fall 2021

Tu/Th 11am-12:20pm, SCI 018

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Office Hours: MWF 9:00-9:50, Tu/Th 1:00-1:50

Course Description: An introductory course in the theory of groups, rings, and fields. Topics include: groups, subgroups, permutation groups, factor groups, homomorphisms and isomorphisms; rings, integral domains, and ideals; fields and their extensions; and applications to number theory, solving polynomial equations and geometry.

Course Prerequisites: Grades of C- or above in MATH 293 and MATH 242

Credits and Workload Expectations: 3 credits: 6 hours per week outside the classroom.

Textbook: *Learning Modern Algebra From Early Attempts to Prove Fermat's Last Theorem*, by Al Cuoco and Joseph J. Rotman

Overview: We take an historical approach to abstract algebra: studying approaches to prove one of the most famous theorems in mathematics, Fermat's Last Theorem (FLT). This is somewhat of a misnomer, because Fermat did not prove this theorem; he merely made a private note in the margin of one of his books claiming to have a proof. After his death, when the margin note, but no proof, was discovered, mathematicians took on the challenge of finding a proof. The "theorem" turned out to be more subtle than anyone expected, and, while a proof eluded mathematicians for centuries, their prodigious efforts drove the creation of abstract algebra. We will start our study in the concrete setting of the integers, then move to more exotic mathematical structures like the Gaussian integers and integers modulo n , which motivate the more abstract notion of a commutative ring. We continue with field theory and end with an introduction to group theory.

Course Objectives:

- Listen to and read mathematics with greater understanding and discernment, particularly in the context of an algebraic argument (M1, ME1, M4, ME4);
- Construct more clear, effective, and precise mathematical proofs (M2, M4, ME4);
- Generally communicate mathematical ideas and information more clearly, effectively, and precisely through both oral and written means (M4, ME4); and
- Exhibit proficiency in both conceptual understanding and computational techniques for the content outlined in the course description. (M1, ME1)

Homework: Homework is assigned in a "rolling trio": reading assignments, discussion problems, and written problems. For example, for Thurs Sep 2, you are to write up the solution to a problem from Section 1.3 (which we will have discussed already, in class Tues Aug 31), work on

discussion problems for Section 1.4 (which we will discuss in class on Thurs Sep 2), and read and answer questions on Section 2.1 (which we will discuss in class Tues Sep 7).

Collaboration and Consultation: I encourage you, when working on homework, to collaborate with fellow students, to reread the textbook, and to ask the professor or the Learning Commons tutors for help. You are also free to consult other textbooks or online resources for general information on the topic. However, *you may not at any point consult any worked solution to an assigned homework problem*. If in doubt about the acceptability of a certain kind of collaboration or consultation, ask the professor. Please see the university policy on academic dishonesty, below.

Late Work: Late work is typically not accepted. The lowest two scores in each assignment category (RQ, D, W) will be dropped at the end of the semester. Extensions on other assignments will be considered if requested before the due date, and work may certainly be submitted before the due date, if arrangements have been made with the professor in advance. If there is a serious, unforeseeable reason for missing more than one week of class, it is the student's responsibility to contact the professor as soon as possible and to make an appointment with the professor upon returning to classes to make a plan, e.g. whether to continue with the course, take an incomplete, or withdraw; and if continuing, how to make up missed work.

Missed Exams: Make-up midterm exams may be given to students with legitimate excuses such as serious illness, university sponsored events, etc., as long as the make-up exam can be taken within a reasonable time frame. If it is not possible to schedule a make-up exam within a reasonable time frame, the grade for the midterm may be prorated from the final exam. Written documentation may be required. Rescheduling the final is not possible except under very extreme circumstances.

Final Course Grade: The overall score for this course will be computed as outlined below. Final letter grades will be assigned based on the overall score, with the two mastery components, written work and exams also being considered separately. In particular, the final letter grade will not be higher than one letter grade above the level of mastery demonstrated on written work or the work on exams. Exceptional performance on the final may also be taken into account.

- Preparation and Participation (10%): reading questions (5%), discussion problems (5%)
- Written Problems (30%): typically one problem per class, written up nicely
- Quizzes (5%): tentatively scheduled for Th Sep 2, Tu Sep 14, Tu Oct 12, Th Nov 18
- Midterm Exams (30%): tentatively scheduled for Tu Sep 21, Th Oct 28, Tu Nov 30
- Final Exam (20%): cumulative; Tu Dec 7, 10:30-12:30
- Best Exam (5%): at the end of the semester, your best exam score will count an extra 5%

Final letter grades will be determined from the overall score as follows:

A	93-100	B+	87-89	B-	80-82	C	73-76	D+	67-69	D-	60-62
A-	90-92	B	83-86	C+	77-79	C-	70-72	D	63-66	F	0-59

Incompletes: Grades of I are normally not given in this course. However, they may be granted due to extenuating circumstances if (i) at least 60% of the course work has been completed at a

level of C or better and (ii) the student demonstrates the ability to complete the remaining coursework outside of the classroom. In such cases, a well-documented petition should be submitted to the professor well before grades are due to the Registrar. Please see the university policies on [incomplete grades](#) and [withdrawing from a class](#).

Learning Commons: Located on the lower level of the Miller/Moore Academic Center (AC), the [Learning Commons](#) offers in-person and online tutoring services to all Bethel students, including help with any sort of writing projects, from conception to completion. Tutors are trained to give thoughtful feedback and advice on a variety of study skills, understanding concepts pertaining to relevant coursework, and overall writing concerns.

DEI: Bethel University respects the dignity of all God's image-bearers, and stands against racism, prejudice, and discrimination. Because Christ calls us to love our neighbor as ourselves, Christian discipleship includes pursuing the good of those who suffer injustice due to their color, race, or ethnicity. Therefore, we aim to continually transform our classrooms into safe and hospitable spaces where we listen to one another with mercy, learn from and value each other with tenacity, and commit to pursuing justice for the most vulnerable in our community.

Accessibility and Accommodations: Bethel University strives to make learning experiences accessible to all participants. If you anticipate or experience physical or academic barriers based on disability, please contact the Center for Academic Success to discuss options. To schedule an appointment, email rachel.kennedy@betheluniversity.edu or call 574-807-7460.

Academic Dishonesty: The student handbook (p. 156) states: "Any act of deceit, falsehood or stealing by unethically copying or using someone else's work in an academic situation is strictly prohibited."

1. A student found guilty of plagiarism or cheating will receive an "F" (zero) for that particular paper, assignment or exam. Should this occur, the professor will have an interview with the student and will submit a written report of the incident to the academic dean.
2. If a second offense should occur, the student will be asked to appear before the professor, the academic dean and the vice president for student development.

The student should realize that at this point continuation in a course and even his/her academic career may be in jeopardy. In the event of a recommendation for dismissal, the matter shall be referred to the Student Development Committee."

Cell Phones: Cell phones must be turned off and stowed in book bags during class. Any student using a cell phone for any reason (without permission) will be asked to leave the class and an unexcused absence will be recorded. Students using cell phones during exams or graded activities may be cited for cheating (at professor's discretion). In the case of expected emergencies, students may seek permission from the professor to leave their cell phones on during class, but the phone must remain in the book bag. Professors reserve the right to have operational cell phones in class.

Covid-19: Students are expected to follow current Bethel University policies (e.g. re: masking); students not in compliance may be asked to leave the classroom and be recorded as absent.

Disclaimer: This syllabus is not a legal contract, but serves as a general outline for the semester. The professor reserves the right to announce in advance necessary adjustments to the course as the need arises.

Tentative Schedule, Abstract Algebra, F2021

Tues	Thurs
Aug 17, 2021	Aug 19, 2021
	Intro to class 1.1 Ancient Mathematics
Aug 24, 2021	Aug 26, 2021
1.2 Diophantus	1.3 Euclid-I
Aug 31, 2021	Sep 2, 2021
1.3 Euclid-II	1.4 Nine Fundamental Properties Quiz 1
Sep 7, 2021	Sep 9, 2021
2.1 Induction, Unique Factorization	2.2 Binomial Theorem 3.1 Classical Formulas
Sep 14, 2021	Sep 16, 2021
3.2 Complex Numbers Quiz 2	3.3 Roots and Powers & 3.4 Gaussian and Eisenstein Integers
Sep 21, 2021	Sep 23, 2021
Exam 1	Appendices 1 & 2: Functions, Equivalence Relations
Sep 28, 2021	Sep 30, 2021
Service Day	4.1 Congruence
Oct 5, 2021	Oct 7, 2021
4.3 Commutative Rings-I	Fall Break

Tues	Thurs
Oct 12, 2021	Oct 14, 2021
4.3 Commutative Rings-II Quiz 3	5.1 Domains and Fraction Fields
Oct 19, 2021	Oct 21, 2021
5.2 Polynomials	5.3 Homomorphisms
Oct 26, 2021	Oct 28, 2021
6.1 Parallels to $\mathbb{Z}$ -I	Exam 2
Nov 2, 2021	Nov 4, 2021
6.1 Parallels to $\mathbb{Z}$ -II	6.2 Irreducibility
Nov 9, 2021	Nov 11, 2021
7.1 Quotient Rings	7.2 Field Theory-I
Nov 16, 2021	Nov 18, 2021
7.2 Field Theory-II	7.2 Field Theory-III Quiz 4
Nov 23, 2021	Nov 25, 2021
<i>Topics from Ch 8 or 9</i>	Thanksgiving
Nov 30, 2021	Dec 2, 2021
Exam 3	<i>More Topics from Ch 8 or 9</i>

Final Exam: Tues Dec 7, 10:30-12:30