Math 341-01, Abstract Algebra, Fall 2023
Tu/Th 11am-12:20pm, SCI 018

Instructor: Dr. Amy DeCelles

Email: `amy.decelles@betheluniversity.edu`
Webpage: https://amydecellesmath.org
Office: Science Building 013
Office phone: 7-7095
Tentative* Office Hours: MT 2-2:50, W 12-12:50 and 3-3:50, R 1-1:50, F 12-12:20

If you anticipate wanting to come to office hours regularly, and none of these times work for you, please email me about this within the first week of the semester.

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

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 Aug 24, you are to write up the solution to a problem from Section 4.3-II (which we will have discussed already, in class Tues Aug 22), work on discussion problems for Section 4.3-III (which we will discuss in class on Thurs Aug 24), and read and answer questions on Section 4.3-IV (which we will discuss in class Tues Aug 29).

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**. Moreover, **you may not use ChatGPT or other AI**

tools unless you have been given explicit permission from the instructor in advance. 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.

Attendance: Attendance in class is expected, and a portion of the final grade comes from preparation for and participation in class. Absences for official university functions will be excused, provided that the instructor is notified in advance. Absences due to qualifying family or medical emergencies will also be excused, though the instructor reserves the right to ask for verification. In the case of an **excused absence**, it is the student's responsibility to **contact the instructor in advance** and, if desired, make arrangements for an assignment to **compensate for the missed class work**.

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 Aug 9, Sep 5, Oct 3, Oct 19, Nov 16, Nov 28

- Midterm Exams (30%): tentatively scheduled for Tu Sep19, Tu Oct 31, Th Nov 30

- Final Exam (20%): cumulative; Tu Dec 5, 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.

Education Majors: Please use the link below to review all appropriate standards.
https://bethelcollege.instructure.com/courses/11416/pages/standards-library

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.

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 See the following pages for a tentative semester schedule and a plan for the first unit, including assigned homework problems.

Tentative Schedule, Abstract Algebra, F2023

Tues	Thurs
Aug 15, 2023	Aug 17, 2023
	Intro to class A.2, Equivalence Relations 4.3-I, Integers mod m (p 154-5)
Aug 22, 2023	Aug 24, 2023
4.3-II, Abstract Commutative Rings (p 156-160)	4.3-III, Units, Fields (p 160-164) Review $\mathbf{C}$, $\mathbf{Z}[i]$, $\mathbf{Z}[\omega]$.
Aug 29, 2023	Aug 31, 2023
4.3-IV, Subrings, Subfields (p 166-167 + notes) **Quiz 1**	5.1-I, Domains & Str. of $\mathbf{Z}$
Sep 5, 2023	Sep 7, 2023
5.1-II, Fraction Fields **Quiz 2**	A.1, Functions & Preview 5.2
Sep 12, 2023	Sep 14, 2023
5.2, Formal Polynomials & Polynomial Functions	Chapel (Spiritual Emphasis)
Sep 19, 2023	Sep 21, 2023
Exam 1 (4.3-5.2)	5.3-I, Homomorphisms (p 206-216)
Sep 26, 2023	Sep 28, 2023
Service Day	5.3-II, Kernel, Image, Ideals (p 216-220)
Oct 3, 2023	Oct 5, 2023
6.1-I, Divisibility, Units, Associates (p 233-234) **Quiz 3**	Fall Break

Tues	Thurs
Oct 10, 2023	Oct 12, 2023
6.1-II, Irreducibility, Roots, Factors (p 234-242)	6.1-III GCDs, Euclid's Lemma (p 243-248)
Oct 17, 2023	Oct 19, 2023
6.1-IV, Unique Factorization, PIDs, UFDs (p 249-258)	6.2-I, Irreducibility **Quiz 4**
Oct 24, 2023	Oct 26, 2023
6.2-II, Roots of Unity	7.1, Quotient Rings
Oct 31, 2023	Nov 2, 2023
Exam 2 (5.3-6.2)	7.2-I, Field Characteristic, Extension Fields (p 287-292)
Nov 7, 2023	Nov 9, 2023
7.2-II, Algebraic Extensions (p 293-297 up to but not including Thm 7.27)	7.2-III, Algebraic Ext'ns (con't) (p 297-299)
Nov 14, 2023	Nov 16, 2023
7.2-IV, Splitting Fields, Class'n of Finite Fields (p 300-305 + notes)	9.1-3, Abel, Galois, Solvability by Radicals, and Symmetry **Quiz 5**
Nov 21, 2023	Nov 23, 2023
9.4-I, Groups, Abelian Groups (p 389-391)	Thanksgiving
Nov 28, 2023	Nov 30, 2023
9.4-II, Group Homomorphisms, Solvable Groups (p 391-395) **Quiz 6**	**Exam 3** (7.1-9.4-I)

Final Exam: Tues Dec 5, 10:30-12:30

Absract Algebra, Unit 1 Plan, F2023

Tues	Thurs
Aug 15, 2023	Aug 17, 2023
	Intro to class A.2, Equivalence Relations 4.3-I, Integers mod m (p 154-5) *Please read A.2 and 4.3-I before class.* In class today: • D A.2: 15, 17; 4.3-I: 36, 37
Aug 22, 2023	Aug 24, 2023
4.3-II, Abstract Commutative Rings (p 156-160) Due today: • Read 4.3-II • D 4.3-II: 31, 32, 42-i, EE* • Read 4.3-III + notes, RQ 4.3-III	4.3-III, Units, Fields (p 160-164 + notes on **C**, **Z**[i], **Z**[ω]) Due today: • W 4.3 54-i* • D 4.3-III: 42-ii, 42-iii, 54-ii, 55 • Read 4.3-IV + notes; RQ 4.3-IV
Aug 29, 2023	Aug 31, 2023
4.3-IV, Subrings, Subfields (p 166-167 + notes) **Quiz 1** (4.3-II) Due today: • W 4.3-III: 44 • D 4.3-IV: 56, 57*, 60-i, 64 • Read 5.1-I + notes; RQ 5.1-I	5.1-I, Domains & Structure of **Z** (p 191-193 + notes on 1.3) Due today: • W 4.3-IV: 59 • D 5.1: 1, 2*, 1.3: 48, 49* • Read 5.1-II; RQ 5.1-II
Sep 5, 2023	Sep 7, 2023
5.1-II, Fraction Fields (p 193-195) **Quiz 2** (4.3-IV) Due today: • W 5.1: 4 • D 5.1: 5, 6 • Read A.1, RQ A.1	A.1, Functions & Preview 5.2 Due today: • W 5.1: 7 • D A.1: 4, 5, 6, 8 • Read 5.2 + notes; RQ 5.2
Sep 12, 2023	Sep 14, 2023
5.2, Formal Polynomials & Polynomial Functions Due today: • D 5.2: 9, 10, 26, 28, (17) • Read 5.3-I, RQ 5.3-I	*No Class* *(Spiritual Emphasis Week Chapel)*
Sep 19, 2023	Sep 21, 2023
Exam 1 (4.3-5.2) *Exam will be 65 minutes; we'll have a 5 minute break, and then a 10 minute preview of 5.3.*	5.3-I, Homomorphisms (p 206-216) Due today: • W 5.2: 14 • D 5.3-I: 29, 33, 34 • Read 5.3-II, RQ 5.3-II

*An asterisk next to a problem indicates that I have modified the problem or provided a hint.
EE stands for "Extra Exercise." See the "Corrections and Modifications" document.
(A problem in parentheses is a challenge problem. Make sure you understand the other problems before attempting the challenge problems.)