MA383: Introduction to Modern Algebra

Baker University — Fall 2022

MWF, 9:30 to 10:20 AM; Collins Library 312

Instructor Information:

Dr. Dylan C. Beck, Visiting Assistant Professor of Mathematics

- email: Dylan.Beck@BakerU.edu or DBeck@BakerU.edu (Capitalization is used for clarity.)
- office: Boyd Science Center 328
- office hours: Tu, 11:00 AM to 1:00 PM; W, 3:00 to 4:00 PM; or by appointment
- pronouns: he / him / his
- textbook: *Abstract Algebra: Theory and Applications* by Thomas W. Judson (PDF)
- web page: https://dylan-c-beck.github.io

Course Description

Per the course catalog, MA 383 is a three credit-hour "advanced algebra course that includes algebraic structures with groups, fields, and rings and their applications."

Course Objectives

Because of its ubiquity in both applied fields such as computer science and cryptography and pure fields like combinatorics and number theory, modern algebra is a fundamental tool in contemporary mathematics. By the end of the course, successful students will be able to

- provide the definition of a group, a field, and a ring;
- provide examples of (non-)abelian groups and (non-)commutative (unital) rings;
- provide the definition of and use the Isomorphism Theorems for groups and rings;
- understand the relationship and distinguish between Euclidean domains, PIDs and UFDs;
- compute the Galois group of a Galois extension of fields; and
- provide examples of applications of modern algebra to (at least) the fields of computer science, cryptography, combinatorics, and number theory.

Course Prerequisites

Enrolled students must have passed both MA 281 (Introduction to Linear Algebra) and MA 291 (Introduction to Higher Mathematics) with a grade of C or higher. Explicitly, students should be familiar with reading and writing mathematical proofs using the language of set theory and the calculus of logic. Over the course of the semester, we will work to further hone these skills.

Course Policies

Class meetings will typically consist of an instructor-led lecture component and a short quiz. Lectures will feature materials from the course notes; these will be made available for students on the instructor's web page, and they will be maintained throughout the semester. Other than on the first day of the semester, short quizzes will be administered at the end of each class period. Each quiz will contain a few questions pertaining to materials from the preceding class; students must be able to provide definitions, answer true-false questions, and compute examples.

Occasionally, student-led activities will be incorporated into course meetings per the instructor's discretion; students will be informed at least one class period in advance if they are expected to prepare materials in order to lead a discussion. Regular and punctual attendance is vital to understanding the materials presented in this course. We will adhere strictly to Baker University guidance on the matter of self-isolating or wearing masks in the classroom.

Coursework, Exams, and Quizzes

Each week, homework will be assigned at the instructor's discretion. Unless otherwise specified, assignments will be due on Moodle at 11:59 PM the Friday after they are given. Late work may not be accepted by the instructor unless proper documentation is provided; however, if a student anticipates an absence and communicates it to the instructor prior to the due date of an assignment, the student may be allowed to submit their work even after the due date.

Each class period other than the first of the semester, a brief quiz will be administered in the last ten minutes of the session. Unless otherwise specified, quizzes will contain one or two definitions, one or two true-false questions, and one or two computational questions related to the material that was covered in class during the *preceding* course meeting.

Exams will be administered three times throughout the semester. Like with the daily quizzes, students will answer true-false questions, compute examples, and provide definitions; however, students must *also* write some proofs on exams. Credit for definitions and true-false questions is administered to the student on an all-or-nothing basis. On the other hand, credit for computations and proofs is earned by the student primarily through citing theorems, demonstrating a command of appropriate proof techniques, and showing work: when the relevant work is shown and a problem is answered correctly, full credit will be awarded. Partial credit may be awarded when it is obvious that a problem was attempted and some pertinent details were supplied.

Before quizzes and exams, each student must demonstrate that their work space is compliant with the regulations and guidelines set out by the instructor. Explicitly, a student is only allowed to have a writing utensil and a scientific calculator on their desk; all other papers and electronic devices must be stored in the student's backpack and placed under or next to their desk. Once all students have cleared their work spaces, the quiz will begin, at which time the student has (at least) 10 minutes to complete the quiz. Once the student has finished the quiz (or time has

expired), the check-out procedure will be initiated by the student bringing their work to the instructor; if they so choose, the student may subsequently leave class for the day.

Student Expectations

Communication between students and the instructor will occur primarily in the classroom and during the instructor's (virtual) office hours; however, each student should check their email and the instructor's web page regularly for course updates and supplementary materials.

Collaboration with classmates on homework is encouraged; however, each student is expected to submit their own work on all assignments, and each student will be graded on their own work as it appears. Consequently, for students working together, it is critical that no party completes any work on behalf of another party and moreover that each party determines their own solutions. Explicitly, students should write original proofs rather than copy from one another; however, students may discuss different techniques or strategies leading to a possible proof.

Outside of class, students should expect to spend (at least) two hours preparing materials and studying for every hour spent in class. Unlike in high school, if a student does not understand the material covered, they should not assume that their instructor will repeat material until it is understood and mastered; rather, each student is expected and encouraged to ask questions as they occur in class. Certainly, all students should devote time to studying course materials outside of class, but if that does not work, students should consider visiting the instructor during his office hours. Do not hesitate to ask questions, as this course is cumulative.

Grade Distribution

Below is a table with the distribution of grades for this course.

type	*quantity*	*weight*	*total*
homework	6	2%	12%
quizzes	38	1%	38%
exams	2	15%	30%
final exam	1	20%	20%

Final Exam

Our final exam will be administered on **Friday, December 9** from **1:00 to 4:00 PM**. Questions from group theory and ring theory will constitute approximately 40% of the exam material; questions from field theory will account for the remaining portion of the exam.