

# MA445: Senior Seminar in Mathematics

Baker University — Spring 2023

MWF, 12:30 to 1:20 PM; Mulvane 409

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# 1 Instructor Information

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

- Discord: <https://discord.gg/KFFJcCaja7> (Enroll here for assistance on homework.)
- email: Dylan.Beck@BakerU.edu (Capitalization is used for clarity.)
- Moodle: <https://bumoodle.bakeru.edu/course/view.php?id=35861>
- office: Boyd Science Center 328
- office hours: MWF, 2:30 to 3:20 PM; Tu, 12:30 to 3:20 PM; or by appointment
- pronouns: he / him / his
- text: *The History of Mathematics: an Introduction* (Seventh Edition) by David M. Burton
- virtual office: [Click to access my virtual office via Zoom.](#) (passcode: 044163)
- web page: <https://dylan-c-beck.github.io>

## 2 Course Information

### 2.1 Course Description

Per the course catalog, MA445 is a three credit-hour course that is aimed to improve the ability of the students enrolled to “solve problems, learn independently, and communicate their results.” Coursework for MA445 includes (but will not be limited to) “in-class problem-solving sessions and weekly readings” that will “form the basis for class discussion.” One crucial component of the course is for students to write “short report[s] on [...] the problems solved in class.” Even more, “students will [...] select an expository article on a mathematical topic [...] to report on in class and [...] an interesting problem [...] to work on throughout the semester.” Last, students must complete the ETS Major Field Exam; this counts toward the student’s course grade.

### 2.2 Course Objectives

Research in mathematics is highly collaborative. Consequently, the goal of MA445 is to introduce students to this atmosphere of collegial discourse and diligent but patient inquisition into some of the most interesting and profound results in mathematical history. Course topics include

- analytic geometry, calculus, and optimization;
- combinatorics and elementary number theory;
- discrete optimization and probability;
- properties of real functions (of several variables), series, and products;
- properties of real numbers (e.g., irrationality and transcendence of  $\pi$  and  $e$ ); and
- the history of mathematics.

Even more, by the end of the course, students are expected to demonstrate a mastery of mathematical writing using deductive reasoning, basic proof techniques, and citations to the existing body of research; these skills will be reflected primarily in write-ups and the student's final presentation. Explicitly, each student is expected to deliver cohesive, compelling, and informative arguments and to intelligently field questions from their peers regarding their topic.

## 2.3 Course Prerequisites

Enrolled students must have passed MA345 (Problem Seminar in Mathematics) and one of MA362 (Modern Geometries), MA383 (Introduction to Modern Algebra), or MA491 (Introduction to Real Analysis). Even more, students should be familiar with mathematical writing and proof techniques. We will work in class to hone these skills over the course of the semester.

## 2.4 Course Policies

Class meetings will typically begin with a short readings quiz from the text; the remainder of the period will be devoted to the student-led problem-solving session with class discussion. Each quiz will contain a few questions pertaining to the assigned readings; students must be able to provide definitions, answer true-false questions, and compute examples. Brief lectures will be given as necessary to introduce relevant material for solving the problem of the day.

Once per month, student presentations of their solutions will be incorporated into one of the class sessions per the instructor's discretion; students will be informed in advance and subsequently provided adequate time to plan if they are expected to present their solutions.

Regular and punctual attendance is vital to understanding the information presented in this course; however, in the event that an absence cannot be avoided, it is the responsibility of the student to inform the instructor by filling out the [Excused Absence Request Form](#) and to make arrangements with the instructor to make up any materials or assignments missed during class.

Unless otherwise specified, the instructor requires that students wear masks in the classroom. We will adhere to [Baker University guidance](#) on other matters pertaining to COVID-19.

## 2.5 Coursework

Each class, students will work collectively to solve a proposed problem. We will discuss at least three problems per week with no expectation that a given problem will be completed; however, over the course of the semester, each student must solve two problems and present their results to the class in a talk format. Questions introduced to the class will range in difficulty as follows.

- Level 1 questions can be solved by direct computation with familiar techniques.
- Level 2 questions can be solved by direct computation with a combination of new and familiar techniques. Often, these problems will require more work than Level 1 questions.
- Level 3 questions are typically conceptual in nature and require a combination of new and familiar techniques in addition to some clever insight or an inspired observation.

Each student must complete at least one Level 3 question; Level 1 questions are off-limits. Even more, two students cannot present solutions for the same problem, and no student may present their solution for any problem twice. Before each talk, students must submit for approval a

formal write-up of their proposed solution; after making any necessary corrections, the student will present their findings to the class. Consult the [course schedule](#) for submission deadlines.

Considering the timely manner of the class, it is imperative that students communicate with the instructor if there is significant difficulty solving the proposed problems. Late submissions may not be accepted 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 after the deadline with no deduction in points.

Each Monday and Friday class period of the semester, a brief quiz will be administered in the first five minutes of the session. Unless otherwise specified, quizzes will relate to the reading material that was assigned from the course textbook during an earlier course meeting.

Participation in meaningful class discussions constitutes a small portion of a student's overall grade. Each meeting, a student will have the opportunity to earn as many as three points toward their participation grade. Explicitly, the point breakdown for participation is as follows.

- One point is awarded to each student for every day that student is present in class.
- One point is awarded to each student for every day that student actively participates in problem solving and contributes to the class discussion through inspired commentary.
- One point is awarded to each student who provides exceptional insight toward a problem.

Each student is expected to earn at least two points per class period; however, it should be the goal of each student to earn the maximum of three points during at least one class period.

Our final exam period will be reserved for student presentations. Each talk must be approximately 20 minutes in duration; the remaining 10 minutes will be allotted for Q&A. Before the commencement of Spring Break on March 13, students must obtain approval from the instructor of a presentation topic for the final exam period. Each student may either choose from a list of possible material or work in tandem with the instructor to determine a topic that is not on the list. Presentations must be given either as a “chalk talk” or using a slide deck; in either case, each student should submit their notes (or slides) to be graded as part of their final project.

Combined with the final presentation, students must submit a written report on their chosen topic. Each report must be typeset in LaTeX or Microsoft Word and provide a general overview of the history and results of the subject matter. Even though students may assume prior knowledge of calculus, linear algebra, and modern algebra, these reports must be reasonably self-contained documents with plenty of exposition and supporting mathematical details such as definitions, examples, propositions, theorems, and proofs. Citations to reference materials are required.

## 2.6 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 [our course Moodle](#) regularly for course updates and supplementary materials.

Collaboration with classmates is encouraged; however, each student is expected to submit their own work on all write-ups, 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. Ultimately, students must clearly indicate their collaborators for each assignment (see Section 3 below).

Outside of class, students should expect to spend (at least) two hours preparing materials and studying for every hour spent in class (see Section 5 below). Unlike in high school, students that do not understand the material covered 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.

## 2.7 Grade Distribution

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

<i>type</i>	<i>quantity</i>	<i>weight</i>	<i>total</i>
ETS Major Field Exam	1	10%	10%
final project	1	40%	40%
participation	80	0.125%	10%
presentations	2	7.5%	15%
quizzes	25	0.4%	10%
write-ups	2	7.5%	15%

We will use the traditional grading scale (e.g., an A is  $\geq 90\%$ ; a B is  $\geq 80\%$  and  $< 90\%$ ; etc.). Each student that completes all quizzes with an average of 70% may drop their lowest quiz score.

## 2.8 Final Exam

Our final exam will be administered on **Tuesday, May 16** from **1:00 to 4:00 PM** in Mulvane 409. Each student will present a 20-minute talk followed by a 10-minute Q&A session.

## 3 Academic Misconduct Policy

Per the official Baker University guidelines, “students [are expected] to have solely completed or prepared the work or research that bears their name and to acknowledge the materials and sources of others; [...] to do their own work and research; to prepare their own reports and papers; and to take examinations without the assistance of others or aids not allowed in the testing procedure.” Even more, Baker University holds that “academic misconduct includes but is not confined to plagiarizing; cheating on tests or examinations; turning in counterfeit reports, tests, and papers; stealing of tests and other academic material; knowingly falsifying academic records or documents; and turning in the same work to more than one class without informing the instructors involved.” Each of the aforementioned terms are in turn defined as follows.

- “Cheating includes possession, use, or receipt of unauthorized aids or assistance. Notes, charts, books, and mechanical devices used in a quiz, test, or examination, but not specifically allowed by the examiner, constitutes cheating. Visually or verbally receiving or giving information during a quiz, test, or examination that is not specifically allowed by the examiner is also cheating.” Cheating may benefit one’s self or one’s neighbor.

- “Counterfeit work includes work submitted as one’s own that was created, researched, or produced by someone else. Submission of the work of another person, joint work as if that work was solely one’s own, or production of work to be submitted in the name of another person are all forms of counterfeit work.” Be sure to clearly indicate the names of any and all collaborators on any assignment that is not completed solely on one’s own.
- “Plagiarism includes presenting as one’s own efforts the work of someone else without proper acknowledgment of that source. It is not enough to copy the work of someone else and provide a citation. Exact copying must be enclosed in quotation marks or properly blocked with an appropriate citation of its origin. Failure to cite paraphrasing in which the basic sentence structure, phraseology, and unique language remain the same constitutes plagiarism as well as failure to acknowledge unique, unusual, or new ideas or facts not the product of one’s own investigation or creativity. It is the student’s responsibility to understand what constitutes plagiarism and how to properly paraphrase and cite sources. When in doubt, it is the student’s responsibility to seek guidance from the instructor.”

If a student engages in academic misconduct, it will be documented by the instructor and the student’s grade will be reduced or an XF will be appended to the student’s academic transcript, in accordance with and as permitted by Baker University. Consequently, the instructor urges that students become familiar with the academic misconduct policy from the [student handbook](#).

## 4 Accommodations Policy

Per the official Baker University guidelines, “Baker University is committed to providing ‘reasonable accommodations’ in keeping with Section 504 of the Rehabilitation Act and the Americans with Disability Act of 1992. Students must provide appropriate documentation of the disability, which should include appropriate diagnostic testing and a recommendation form prepared by qualified personnel outside of Baker University. ‘Reasonable accommodations’ will be determined by university staff in consultation with the student, faculty, and / or staff member. Accommodations are not retroactive.” Further information is provided [here](#) and [here](#).

## 5 Credit Hour Definition

Baker University adheres to the federal definition of a credit hour as “an amount of work represented in intended learning outcomes and verified by evidence of student achievement that is an institutionally established equivalency that reasonably approximates not less than (1.) one hour of classroom or direct faculty instruction and a minimum of two hours of out-of-class student work each week for approximately fifteen weeks for one semester [...] hour of credit [...]; or (2.) at least an equivalent amount of work as required in [the first] definition for other academic activities as established by the institution, including laboratory work, internships, practica, studio work, distance learning, and other academic work leading to the award of credit hours.” Courses at Baker University are typically 50 minutes in duration. Further information is provided [here](#).

## 6 Update Clause

Ultimately, the instructor reserves the right to alter or update this syllabus in order to reflect changes in policy or schedule due to extenuating or otherwise unforeseen circumstances. Consequently, it is the responsibility of the students to remain up-to-date with this syllabus; however, the instructor will inform students of any such changes to this document, and the syllabus will be maintained and subsequently updated on the instructor's web page for the students' convenience.