

MA491: Introduction to Real Analysis

Baker University — Spring 2024

MWF, 2:30 PM to 3:20 PM; Mulvane 201

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Instructor Information

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

- Discord: <https://discord.gg/CbhmPBQfWv> (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=38847>
- office: Boyd Science Center 328
- office hours: MWF, 9:30 to 10 AM; 10:30 to 11 AM; 3:30 to 4:30 PM; or by appointment
- pronouns: he / him / his
- text: *Introduction to Real Analysis* (Fourth Edition) by R.G. Bartle and D.R. Sherbert
- virtual office: [Click to access my virtual office via Zoom.](#) (passcode: 044163)
- web page: <https://dylan-c-beck.github.io>

Course Information

Course Description

Per the course catalog, MA491 is a three credit-hour “advanced course in calculus” that covers limits, continuity, differentiability, integrability, and infinite series using definitions and proofs.

Course Objectives

On its own, real analysis plays an indispensable role in the development of fundamental tools in applied mathematics and physics; however, for advanced undergraduate students in mathematics, the study of real analysis is crucial in fostering critical thinking and mathematical maturity through an axiomatic approach. By the end of the course, each student should strive to

- describe the real numbers and its subsets according to arithmetic and geometric properties;
- compute limits of infinite sequences of real numbers according to the definition;
- compute limits and derivatives and establish continuity of real functions by definition;
- prove and use fundamental theorems from calculus, e.g., the Monotone Convergence Theorem, the Mean Value Theorem, and the Fundamental Theorem of Calculus; and
- determine the Riemann integrability of a real univariate function by the definition.

Course Prerequisites

Enrolled students must have passed MA271 (Calculus III) and MA291 (Introduction to Higher Mathematics) with a grade of C or higher. Explicitly, students ought to be familiar with reading and writing mathematical proofs using the language of set theory, the calculus of logic, and the axioms provided. 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 during which students will take notes, ask questions, and participate in discussion. Each student should be prepared to interact with the instructor, their classmates, and the course materials each class meeting; the instructor may call on students to facilitate learning. Often, a short quiz with no more than five questions pertaining to materials already introduced will be administered in class. Explicitly, on a quiz, students must be able to provide definitions of key terms, answer true-false and multiple-choice questions, compute examples, and write rigorous proofs (see [Coursework, Exams, and Quizzes](#)). Exam reviews will be hosted during class prior to assessments (see the [course schedule](#)).

Each student must submit their phone face-down on the table at the front of the room at the beginning of each class period, and the device must be left there for the duration of the meeting (barring extenuating circumstances that merit phone usage). Failure to comply with this policy will result in a deduction of a quarter of a percentage point from the student's overall grade.

Regular and punctual attendance is vital to understanding the information presented in this course; however, in the event of an unavoidable absence, 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.

Even more, in view of the instructor's obligation to provide timely feedback on assignments, unless granted explicit permission from the instructor, students may not submit work more than 48 hours past the due date; toward this end, the instructor reserves the right to deny any student of comments or credit on any assignment submitted 48 hours past the due date. Crucially, unless granted explicit permission from the instructor, it remains the responsibility of any student that misses class (due to illness or extenuating circumstances) to submit their homework on time.

Conversely, the instructor reserves the right to deny any student of comments or feedback on any assignment submitted in advance of the due date. Explicitly, the instructor may refuse to review, revise, or otherwise provide assistance on an assignment outside of office hours.

Coursework, Exams, and Quizzes

Each week, at the instructor's discretion, relevant written homework will be issued to be completed outside of class. Consult the [course schedule](#) for specific due dates regarding assignments. Late work may not be accepted unless proper documentation is provided. Even more, late work that is accepted may be subject to a deduction of one letter grade for each class period beyond the due date; however, if the student anticipates and communicates an issue to the instructor at least one calendar week prior to the assignment due date, the student may be allowed to submit their work after the due date with no deduction in points (see the policy in [Course Policies](#)).

Every Monday and Friday of the semester, if an exam is not administered, a brief quiz will be administered in the last ten minutes of the class meeting. Unless otherwise specified, quiz questions will include definitions of key terms, true-false statements, and computational short response related to the material that was covered in class during an earlier course meeting.

Exams will be administered five times during the semester. Like with quizzes, students will evaluate true-false and multiple choice questions, compute examples, and write rigorous proofs. Credit for true-false and multiple choice questions is awarded to students on an all-or-nothing basis. Credit for computations and proofs is earned by the student primarily through citing relevant definitions and theorems, demonstrating a command of appropriate (proof) techniques, and showing work: when the relevant work is provided and a problem is answered correctly, full

credit will be awarded. Partial credit may be awarded if some pertinent details are supplied; in this case, the instructor will typically mark the student's work with the phrase, "Work follows." Each student must comply with the following exam regulations and guidelines.

- Each student is allowed a writing utensil and a non-graphing, non-programmable scientific calculator without computer algebra capabilities. Graphing calculators are prohibited.
- Other papers and electronic devices must be stored in the student's backpack and placed under or next to their desk. Explicitly, use of notes and textbooks is prohibited.

Once all students have cleared their work spaces, the assessment will begin, at which time each student will have 50 minutes to complete the exam. Once the student has finished the assessment (or time has expired), the check-out procedure must be initiated by the student submitting their work to the instructor; if desired, the student may subsequently leave class for the day. Below is a brief list of authorized handheld calculators for use on quizzes and exams in MA491.

- TI-30XIIS
- TI-34
- TI-30XA
- Casio fx-300ESPLUS

Calculators other than those listed above may be used with the instructor's explicit permission.

Discord

Considering that it may be difficult for some students to attend weekly office hours, the instructor may elect to maintain a **Discord** server where individuals may reach out for homework assistance, ask questions regarding course policies or assignment due dates, and discuss course material with their classmates and the instructor. Crucially, engagement on Discord is optional: concretely,

- participation on Discord is not required as part of the MA491 coursework;
- interactions on Discord will not influence the student's grade in the course; and
- Discord should not be viewed an official medium of communication between the instructor and the students at Baker University. Explicitly, Baker email remains the official mode of communication between the students at Baker University and their instructor.

Even more, students are forbidden from directly messaging the instructor via Discord, and any comments made by students on the MA491 Discord may be viewed by their classmates. Bearing this in mind, it cannot be understated that confidential information must not be shared on Discord. Critically, the instructor is obligated according to **Baker University policy** to report any "illegal, unethical, or improper activities" on the Discord server to the appropriate authorities.

Communication and 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 Baker email and the course **Moodle** regularly for class announcements and supplementary materials. Even more, students are encouraged to join the **MA491 Discord** for additional assistance.

Generally, the instructor will adhere to Baker University's [Hours of Operation](#) as it pertains to attending office hours, conducting make-up exams, and responding to emails or other correspondence from students; therefore, students should be conscientious and cognizant of this time frame when seeking assistance with assignments or scheduling appointments with the instructor. Even more, the instructor reserves the right at least 48 hours to respond to any correspondence sent during the business week (Monday through Friday, excluding holidays) or more on weekends.

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 work as it appears. Consequently, for students working together, it is critical that no party completes any work on behalf of another party and that each party determines their own solutions. Explicitly, students should write original solutions rather than copy from one another; however, students may discuss relevant techniques or strategies for their work. Ultimately, students must clearly indicate their collaborators for each assignment (refer to the [Academic Misconduct Policy](#)).

Outside of class, students should expect to spend (at least) two hours preparing materials and studying for every hour spent in class (refer to the [Credit Hour Definition](#)). Unlike in high school, students that do not understand coursework should not assume the instructor will repeat material until it is mastered; rather, each student is expected and encouraged to ask questions as they arise. Each student should certainly devote time to studying course materials outside of class, but in the event of confusion or difficulty, students should consider visiting the instructor during his office hours. **Do not hesitate to ask questions, as this course is cumulative.**

Crucially, it should be duly noted that the instructor reserves the right to refuse any accommodations requested by the student after the last day of classes of the semester — especially if the aforementioned arrangements are negotiated in an attempt to improve the student's course average or to achieve a desired letter grade in the class. **Consequently, it is imperative that students communicate early and often any difficulty or concern to the instructor.**

Grade Distribution

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

type	quantity	weight	total
exam	4	12.5%	50%
final exam	1	25%	25%
homework	8	1.25%	10%
quiz	20	0.75%	15%

Below is a table with the projected grading scale used for this course.

grade	minimum	maximum
A	90%	100%
B	80%	89.99%
C	70%	79.99%
D	60%	69.99%
F	0%	59.99%

Once during the semester, students will have the opportunity to earn up to one percentage point toward their overall grade by completing the [MA491 Syllabus Quiz](#) on the course Moodle.

Each student that completes all homework assignments with an average homework score of at least 67% will have their lowest two homework scores dropped. Each student that completes all quizzes with an average quiz score of at least 67% will have their lowest four quiz scores dropped.

Final Exam

Our final examination will be administered on **Friday, May 17** from **1:00 PM to 4:00 PM** in Mulvane 201. Each of the four units covered will account for about 25% of the final material. Completion of each of the four unit exams is required in addition to the final exam. Even more, each student who scores twice as many percentage points on their final exam as their lowest exam score will be eligible to replace their lowest exam score with half of their final exam score.

Academic Misconduct Policy

Per the **Academic Misconduct Policy** of Baker University, “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 these aforementioned terms are in turn defined as follows.

- “Cheating includes possession, use, or receipt of unauthorized aids or assistance,” hence “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.” Consequently, in order to avoid charges of academic misconduct, it is imperative that students 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](#).

Accommodations Policy

Per the [Access Services Policies and Procedures](#), "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 in the [ADA Policy](#).

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](#).

Update Clause

Ultimately, the instructor reserves the right at any point in the semester to alter this syllabus to reflect changes in policy or schedule due to extenuating or 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.