MATH 506.01 – MODERN ANALYSIS FOR TEACHERS

SPRING 2023

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Lecture Hours: 10:00am - 10:50am, 200 Wickersham Hall

Office Hours: Monday: 11:00 - 11:30, Tuesday: 1:10 - 3:10, Wednesday: 11:00 - 11:30 and 1:00 - 2:30, Friday: 11:00 - 11:30. As necessary, changes to or additional office hours will be posted on D2L. If you would like to meet with me but cannot make the posted times, see me after class or email me and we'll set an appointment. I am also around at other times, so feel free to drop in.

Description: In this course we attempt a rigorous development of the theory of calculus from first principles. We give careful definitions of terms, and correct proofs of theorems. We will give a development of the real number system and its topology; the theory of limits and continuity; introduce differentiable functions and their properties; and discuss the Reimann integral. Prerequisites for this course are a C- or higher in MATH 311 and MATH 345.

Required Text: *"Elements of Real Analysis",* by Charles G. Denlinger (First Edition)

Desire2Learn: A D2L site has been set up for this course. Daily and hand-in homework assignments will be posted there, as well as copies of all handouts distributed in class.

Attendance: Attendance is not compulsory but is highly recommended (and you lose points if you miss graded work).

Classroom Policies: All cellphones should be set on silent or, preferably, turned off for the duration of class.

Please do not bring any food to consume during class.

Students should comply fully with all COVID-19 mitigation efforts mandated by MU.

Homework: Homework will be assigned daily and is an essential part of the course. I will specify which of the problems I would like you to hand in to be graded. The daily homework assignments and the problems to be handed in will be announced in class, and can be found on the D2L site for the course. For homework that is handed in after the specified due date, 25% of the total points will be deducted for each class date that the homework is late, unless a valid excuse is given. You may hand in your homework early. No homework will be accepted more than two class days after the due date.

Graduate Credit: There will be four additional assignments, distributed over the course of the semester:

- Essay - “An historical figure in Real Analysis.” The student will select an individual from a short list of individuals who have historically made a significant contribution to the field of Real Analysis. The essay will include biographical details, a short description of significant contributions to the field, and an overview of the social environment(s) within which the mathematician worked, including a description of advancements made in other scientific fields at the time. The essay will be 3-4 pages in length.
- Additional Topic 1: “Cauchy Sequences of Real Numbers.” This is an optional topic included on the chapter on sequences of real numbers. The student will engage in self-study of the required material and complete a collection of problems covering the topic. I will meet with the student periodically to discuss the topic.
- Additional Topic 2: “Cauchy Sequences of Functions.” This is an optional topic included on the chapter on sequences of real numbers. The student will engage in self-study of the required material and complete a collection of problems covering the topic. I will meet with the student periodically to discuss the topic.
- Essay - “Women in Real Analysis.” The student will select an individual from a short list of female individuals who have historically made a significant contribution to the field of Real Analysis. The essay will include biographical details, a short description of significant contributions to the field, and an overview of the social environment(s) within which the mathematician worked, focussing on the particular challenges faced by this individual working as a woman in mathematics. The essay will be 3-4 pages in length.

Exams: There will be two 100-point in-class exams and one 150-point final exam. The final exam for this section will be held on Thursday, May 4th, 2023, from 8:00am - 10:00am. You will need a documented excuse to take a test at any time other than the scheduled time. If possible, contact me ahead of time so that alternative arrangements can be made. Tests will not be rescheduled to accommodate vacation travel - be sure to make your travel arrangements so that they do not conflict with exams, class times or deadlines.

Grading: Your grade will be calculated based on the following point distribution:

2 In-class Exams:	200
Final Exam:	150
Homework Sets:	100
Journal Project:	20
Essays (30 points each):	60
Additional Homework (20 points each):	40
Total points:	**570**

Grades will be assigned based on the following scale:

Percentage Range	Grade
93.0 - 100.0	A
90.0 - 92.9	A-
87.0 - 89.9	B+
83.0 - 86.9	B
80.0 - 82.9	B-
77.0 - 79.9	C+
73.0 - 76.9	C
70.0 - 72.9	C-
67.0 - 69.9	D+
63.0 - 66.9	D
60.0 - 62.9	D-
0 - 59.9	F

Special Accommodations: ADA Program (Office of Learning Services) Americans With Disability Act (if you have a disability that requires accommodations under the Americans with Disabilities Act, please present your letter of accommodations and meet with me as soon as possible so that I can support your success in an informed manner. Accommodations cannot be granted retroactively. If you would like to know more about the Millersville University Office of Learning Services - please contact the office at 717-871-5554)

Required Syllabus Language: All links are active in the pdf version of this syllabus available on the D2L site for this course.

- Academic Honesty Policy
- Attendance Policy (Class Attendance, Drop for Non-Attendance)
- Inclusion Statement
- Land Acknowledgement
- Policy on Delays and Cancellations
- Preferred Names Policy (FAQ's)
- Privacy Rights under FERPA
- Student Conduct and Community Standards
- Title IX Reporting Requirements and the Faculty member (MU Protection of Minors policy, Title IX Information)

MATH 506.01: Journal Project

What is it? Every Monday at the beginning of class you will hand in a journal entry. This entry will consist of two parts:

1. A summary of the definitions learned in the previous week.
2. At least two "Connections". A connection describes how concepts are related. You should state these connections in your own words, not just restate definitions or a theorem. You could also give a real-world analogy for a concept. Try to be detailed and specific in your connections, (not just: "This reminds me of that.") Some examples for connections would be the following:
   - Suppose that you have just learned the definition of the limit of a function (in Chapter 4.) You could describe how this is similar to (or different from) the definition of the limit of a sequence that you learned in Chapter 2.
   - If you have seen one of the concepts in another course, how is it the same/different? For example, when you learned about sets in MATH 310, you may have also seen similar topics in CSCI 140, or used set theory in another course.
   - If one of the concepts makes you think about a real-world scenario, how are they similar? For example, factoring is kind of like breaking a cake down into its individual ingredients.

How is it graded? You will receive a score of 0, 1, or 2 for each journal entry. You will receive a score of 2 if the entry is complete and correct; a score of 1 if the entry is partially complete and/or contains errors; and a score of 0 otherwise.

How does this help me? The study of analysis requires a firm grasp of the basic definitions, but it is also important to see the picture at large. The notion of convergence, for example, is consistent whether we are talking about a sequence or a function. My goal with this journal is to help you to reinforce the definitions as we learn them, as well as to help you reflect on how the material that you are currently covering relates to material in earlier sections.

Sample Journal Entry:

- Definitions:
  1. A quadratic equation is an equation of the form $ax^2 + bx + c = 0$, where a, b, *and* c are real numbers and $a \neq 0$.
  2. The zero-factor property states that if the product of 2 or more real numbers is zero, one of the numbers must be zero.
- Connection: When we solve a quadratic equation by factoring, we use the zero factor property to reduce the problem to that of solving multiple linear equations, which we learned how to solve in Chapter 1.