Fall 2020
Math 5615H: Introduction to Analysis.

Class Times and Location:
Section 002, MWF, 2:30 pm – 3:20 pm, remote, via Zoom.

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Office Hours: MWF, 3:20 pm – 4:30 pm, or until all the questions are settled, immediately after the lecture, remote, via Zoom.

Textbook: *Walter Rudin*, Principles of Mathematical Analysis, 3rd edition, 1976. We tentatively plan to cover Chapters 1–5 during Fall semester, and Chapters 6–9, 11 during Spring semester 2017. Notes will be provided for material not covered by this book, or covered in a different way.

Supplementary Readings: The Library Course Page contains a link to **Solutions Manual to the textbook**, which can be downloaded as pdf files for each chapter: https://libguides.umn.edu/MATH/5615H

The prerequisites for this course include Linear Algebra and Calculus III, so that the students are already familiar with differentiation and integrations at an elementary level, despite these concepts are covered only in the second half of the textbook. As a unified reference on the background material, we will use another text:
[TBB] Elementary Real Analysis, Second Edition (2008) by Brian S. Thomson, Judith B. Bruckner, and Andrew M. Bruckner, which is freely available online in pdf format.

Some lecture notes will be provided for material not covered by these two books.

There will be 6 Homework assignments, a take home Midterm Exam, and a take home Final Exam. The tentative schedule is as follows.

Week 3. Wednesday, September 23, Homework 1 is due.
Week 5. Wednesday, October 7, Homework 2 is due.
Week 7. Wednesday, October 21, Midterm Exam.
Week 8. Friday, October 30, Homework 3 is due.
Week 10. Friday, November 13, Homework 4 is due.
Week 12. Wednesday, November 25, Homework 5 is due.
Week 14. Wednesday, December 9, Homework 6 is due.
Week 15. Saturday, December 19, Final Exam.

Each homework is due at the beginning of class (till 2:30 pm). The time frame for Midterm and Final Exams will be specified later. As a general guideline, Final is longer and more comprehensive than Midterm.

Grading: *Homeworks* - 35% total for 5 HW projects,
Midterm Exam - 25%, *Final Exam* - 40%.

Missed exams: Make-up Final exams will be given to students who have a **valid** reason for missing an exam. Such students must notify their instructor prior to the exam, and the reason must be documented. There will be **no make-up Midterm exams**. A proportional part of the score for the Final exam will be used instead for students who have a valid documented reason for missing a Midterm exam.

Incompletes: The grade of **I** can be assigned only to students who have taken and passed one Midterm Exams and who have a **valid** excuse for being unable to take the Final Exam.

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Tentative coverage of the textbook:
Weeks 1–2: Chapter 1.
Weeks 3–4: Chapter 2.
Weeks 5–9: Chapter 3.
Weeks 10–12: Chapter 4.
Weeks 13–15: Chapter 5.

Homework #1 (due on Wednesday, September 23):

I. Exercises 2, 4, 8 in Chapter 1 of the textbook.
II. 1. Verify if the following real numbers are rational or irrational:

$$(\mathbf{a})\ \sqrt{2}+\sqrt{3}, \quad (\mathbf{b})\ \sqrt{2}+\sqrt[3]{3}, \quad (\mathbf{c})\ \sqrt{3+\sqrt{8}}-\sqrt{3-\sqrt{8}}.$$

2. Prove that the numbers $A_n = (1+\sqrt{2})^n + (1-\sqrt{2})^n$ are integers for all $n = 0, 1, 2, , \ldots$.
3. Represent the periodic decimal fraction $r = 0.(461538) = 0.461538461538\ldots$ in the form $r = m/n$ with integers m and n.
4. Define $e^{it} = \cos t + i \sin t$, where $i^2 = -1$. Show that $e^{i(s+t)} = e^{is} \cdot e^{it}$.
5. Using the fact (without proof) that the algebraic equation $z^n = r \cdot e^{it}$, where $r > 0,\ n = 1, 2, \ldots$, has n distinct roots

$$z_k = \sqrt[n]{r} \cdot e^{i(t+2k\pi)/n}; \quad k = 0, 1, \ldots, n-1,$$

write the polynomial $z^4 + 4$ in the form $(z-z_0)(z-z_1)(z-z_2)(z-z_3)$, and group together linear factors in order to represent it as

$$z^4 + 4 = (z^2 + p_1 z + q_1)(z^2 + p_2 z + q_2) \quad \text{with } \textbf{real} \quad p_{1,2},\ q_{1,2}.$$