Analysis, Spring 2018
MST-711

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Course Website: http://users.wfu.edu/gemmerj/math711.html
Office Hours: Tuesday 9-10, Wednesday 1-2, Thursday 2-4
Jessica's Hour: Thursday 9-10 (Room TBA)
Class Meeting Times: MWF 9:00-9:50
Class Location: Manchester 124

Textbooks:

1. (Main) Raynor and Robinson, *Analysis on Metric Spaces: A First Graduate Analysis Text:* Purchasable from the math office.
2. (Optional) Hunter and Nachtergaele, *Applied Analysis*. World Scientific Publishing Co Inc, 2001
   https://www.math.ucdavis.edu/~hunter/book/pdfbook.html

Prerequisites: Analysis at the MST-611 level. Students should be comfortable with fundamental concepts from analysis: definition of limits, differentiation, Riemann integration, Cauchy sequences, compactness (Bolzano-Weirestrass), continuity. Moreover, this course assumes that students are comfortable writing rigorous mathematics.

Course Description: This is a first graduate analysis course with specific focus on elementary infinite dimensional spaces. The course will be equal parts theory and applications. Specific topics covered will include: metric spaces, normed linear spaces, Hilbert and Banach spaces, Arzela-Ascoli theorem, compact embeddings, inverse function theorem, and calculus of variations. Applications will include, but are not limited to: weak solutions to boundary value problems, Fourier analysis, approximation theory, contraction mapping theorem, Newton's method, and bifurcation theory. Depending on time and interest additional topics from distribution theory, integral equations, wavelets, weak convergence, the Banach-Alaoglu theorem, ordinary differential equations, partial differential equations, and optimization may be discussed.

Course Rationale: The purpose of this course is to re-introduce the student to the study of analysis from a more modern perspective. Typically an undergraduate course in analysis focuses on training the student to be a rigorous mathematician by studying the foundations of calculus. This is an incredibly important and sometimes painful part of a young mathematicians education. However, the price that is often paid is that students grow disinterested in studying analysis, obtain a narrow view of the subject, and fail to gain the intuition behind the subject. Here is an interesting quote from Terry Tao on mathematical rigor that I believe aligns closely with my own views:

> "The point of rigour is not to destroy all intuition; instead, *it should be used to destroy bad intuition while clarifying and elevating good intuition*. It is only with a combination of both rigorous formalism and good intuition that one can tackle complex mathematical problems;

one needs the former to correctly deal with the fine details, and the latter to correctly deal with the big picture. Without one or the other, you will spend a lot of time blundering around in the dark (which can be instructive, but is highly inefficient). So once you are fully comfortable with rigorous mathematical thinking, you should revisit your intuitions on the subject and use your new thinking skills to test and refine these intuitions rather than discard them."

While a strong focus of the course will be to ensure that students gain an understanding of the the concepts listed in the Course Description, a secondary focus will be to develop students mathematical intuition. A goal in all of my classes is to have students begin to see the big picture and learn how to use mathematics and critical thinking beyond the narrow scope of the course. These are the skills that will benefit you throughout your career whether it is in industry, research, or academia.

Course Delivery: The course material will be delivered through a combination of lectures. Evaluation of the students understanding of the material will be assessed through written homework assignments, in-class exams, in-class quizzes, and a final exam.

Jessica's Hour: Jessica will be holding an office hour on Thursdays at 9:00. In this hour Jessica will be available to assist with homework assignments. **I would strongly encourage you to attend.** The best way we learn mathematics is through interaction with our peers and Jessica's hour will provide an ideal format for fostering this type of growth.

Course Policies:

✦ **Grading:**

Your grade will be based on:

- Weekly Homework: 35%
- Quizzes: 5%
- Two in-class exams: 30% (15% each)
- Final Exam: 30%

You are guaranteed the following grades if your final percentage lies within the following ranges:

90-92.9: A-	**93-100: A**	
80-82.9: B-	**83-86.9: B**	**87-89.9: B+**
70-72.9: C-	**73-76.9: C**	**77-79.9: C+**
60-62.9: D-	**63-66.9: D**	**67-69.9: D+**

✦ **Homework:**

Homework will be assigned most weeks on Monday and will be due Monday of the following week. The assigned homework problems will be posted on my website.

✦ **Exams:**
There will be two exams and a comprehensive final in the course. All exams will be in-class.

✦ **Quizzes:** On most Fridays there will be a short 5-10 minute in-class quiz. These quizzes will consist of a very short problem that will test your knowledge of the prior lectures. These quizzes are to help both the students *and* the instructor understand concepts that students may be struggling with. All quizzes will be announced in class. *There will be no "pop" quizzes*. There are no retakes for missed quizzes, however I will drop the lowest quiz score from your final grade. Quizzes are often indicative of how the instructor grades and what concepts will be emphasized on exams.

Important Dates:

1. February 16: Exam 1.
2. March 30: Exam 2.
3. Final Exam: TBD

The Honor Code: At Wake Forest, we expect you to behave as honorable citizens of the class, the university, and the world as a whole. When you complete an assignment with your name on it, you are representing that everything you are turning in is your own work. That means that you do not copy from other students, textbooks, or websites. If at any time I become aware of cheating or plagiarism in this course, I will submit the information to the honor council.