

Math 5290-80: Topics in Analysis

Summer 2010

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Meeting Times: MTWR, 8:20am-10:10am

Office Hours: TBA

Course Website: TBA

Textbook: There is no required textbook for this course. Notes and other supplementary materials will be provided as we proceed with the course. Some books for further reading will be posted on the website.

Grading: Exercises (30%) will be given during class. These will be solved either during class or outside of class depending on time constraints. The solutions will be presented (usually in groups) to the class and I will grade for correctness and clarity of exposition. They are intended to drive the course and the discussions. In terms of tests, there will be a **Take-home Midterm Exam** (25%) and a **Take-home Final Exam** (25%). There will be a **Project** (20%), to be thought about and worked on throughout the course, that involves preparing one or two class lessons with the goal of introducing (or preparing students for) some topics from this class in courses that you teach or plan to teach.

Course Description: The main purpose of this course is to introduce you to some key ideas that fall under the umbrella known as continuous mathematics. Roughly speaking, any notion of continuity introduces the concepts of approximation and limit, which are two of the most important tools in mathematics and its applications. Instead of proceeding in an exhaustive definition-lemma-theorem manner, we will opt for a question/problem-based approach with the intention of understanding why continuity is introduced in the first place and how these basic notions lead to some of the most fascinating and beautiful results in mathematics. Here is an outline of the course.

Week 1 On each of the first four days, we will introduce one of the four themes for the course.

Day 1 Finding zeros: meaning and existence

Day 2 Approximating the complex

Day 3 Optimization and all that

Day 4 Topology: new directions in continuity

Week 2 More fully examine the ideas from Day 1, i.e., completeness of the real line, continuity of functions, root-finding algorithms, contraction mappings, fixed-point results, etc.

Week 3 Continue with Day 1 topics and transition to Day 2 topics, i.e., closeness of functions, sequences of functions, approximations by polynomials, etc.

Week 4 Continue with Day 2 topics and transition to Day 3 topics, i.e., optimization of functions, basic calculus of variations ideas, the brachistochrone problem, etc.

Week 5 Continue with Day 3 topics and transition to Day 4 topics, i.e., neighborhoods, homeomorphisms, deforming paths, etc.

Week 6 Continue with Day 4 topics, i.e., the fundamental group, reconnecting with fixed-point theorems, now in a topological setting.

The information in this syllabus is subject to change. Any changes will be announced.

Recommended Texts

Abbott, S. (2001). *Understanding analysis*. NY, NY: Spring Science + Business Media, Inc.

Hairer, E. & Wanner, G. (2008). *Analysis by its history: Undergraduate texts in mathematics*. NY, NY:

Spring Science + Business Media, Inc.

Websites and Applet Links

- Continuous Math Course Website
http://www.uwyo.edu/selden_homepage/Continuous/Continuous.html
- Dr. Selden Homepage
http://www.uwyo.edu/selden_homepage/
- Bernstein polynomial link
http://mathdl.maa.org/images/upload_library/4/vol6/Mayans/Weierstrass.html
- Uniform convergence link
http://www.nd.edu/~jcaine1/java/HCI/Uniform_vs_Nonuniform_Convergence.html
- Loop Contractions
http://www.uwyo.edu/selden_homepage/Continuous/loopcontraction.html
- Loop Deformation
http://www.uwyo.edu/selden_homepage/Continuous/homotopy1.html
- Pendulum Energy Surface
http://www.uwyo.edu/selden_homepage/Continuous/energy%20surface.pdf
- Pendulum Phase Diagram
<http://www.myphysicslab.com/pendulum1.html>
- Pendulum Video
http://www.uwyo.edu/selden_homepage/Continuous/Pendulum_video.wmv
- Phase Portrait for SHM vs Pendulum (Wolfram)
<http://mathworld.wolfram.com/PhasePortrait.html>
- SHM vs Pendulum
<http://positron.ps.uci.edu/~dkirkby/music/html/demos/SimpleHarmonicMotion/index.html>
- Shortest Path
http://www.uwyo.edu/selden_homepage/Continuous/Euclidean_Shortest_Path.html
- Arc Length
<http://www.calculusapplets.com/arclength.html>
- Function Distance
http://www.uwyo.edu/selden_homepage/Continuous/function_distance.html