Mathematics 4200-001 Fall 2019

Class Time and Place: M, W, F 11:50-12:40 LCB 222

Class website http://www.math.utah.edu/~korevaar/4200fall19

Instructor: Professor Nick Korevaar 801-581-7318
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Office Hours: M, W 12:50-1:30 T 11:50-12:40, and by appointment.

Text: *Basic Complex Analysis, third edition* by Jerrold E. Marsden and Michael J. Hoffman

Prerequisites: Math 3210-3220 or equivalent; we will use concepts from analysis including estimation via the triangle inequality; continuity; the derivative matrix and differentiability of multivariable functions; path integrals and Green's Theorem. Section 1.4 of the text contains a review of many but not all of these concepts, as they will be applied in our context. (We will spend about two lectures on this review.) You will be expected to learn and be able to explain the key theorems in this course, and your homework will include theoretical problems along with computations and applications.

Course Description: The unfortunately named ``imaginary" and ``complex numbers" were originally introduced by Geronimo Cardano in the 1500's as an algebraic artifice to factor polynomials. Probably all of you first encountered i, the square root of -1, and complex numbers $a+bi$ when factoring quadratic equations. You may know, e.g. from Math 2270, that complex numbers share the same field axioms for addition and multiplication as do the real numbers. You have also seen Leonhard Euler's beautiful formula from the 1600's,

$$e^{i\theta} = \cos(\theta)+i\sin(\theta),$$

and its applications to differential equations. However, it was not until the 1800's that mathematicians including Karl Friedrich Gauss, Augustin Cauchy, Peter Dirichlet, Karl Weierstrass and Georg Friedrich Bernhard Riemann more fully developed the field known as Complex Analysis. This is a core area of study and to the present day remains an essential tool in many areas of mathematics and science.

In this class we will systematically develop the theory, the calculus and the magic of complex analysis, chapters 1-5 of our text. In chapters 5 and 8 we will see some classical applications of complex analysis to partial and ordinary differential equations. Time permitting, and hopefully with student project input, we will see other diverse applications of complex analysis, for example, to fluid mechanics, minimal surfaces, Riemann surfaces, Julia set fractals, hyperbolic geometry, the prime number theorem, or other suitable topics which suit your fancy and are also agreeable to me.

Grading: There will be two midterms, a comprehensive final examination, and homework. Each midterm will count for 20% of your grade, homework will count for 30%, and the final exam will make up the remaining 30%. All exams will be given in our classroom. The midterm exam dates are **Wednesday October 2** and **Wednesday November 13**. The final exam is at the University time and date of **Friday December 13, 10:30-12:30** in our usual classroom.

You may opt out of the final exam by completing a project (by yourself or with one or two other people) on some application as indicated above. Each project shall consist of a 5-10 page expository paper, and a presentation to the class of at least 20 minutes in length, but possibly longer. I will be available for pre-presentation consultation and practice. Project groups and topics must be approved by me, **by Friday November 1**.

Homework assigned by Wednesday of each week will be collected the following Wednesday, in order that it may be graded. Work individually and collaboratively, but everyone should carefully write up their own final solutions to hand in.

Safety: The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit *safeu.utah.edu*.

Students with disabilities: The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, 581-5020. CDS will work with you and the instructor to make arrangements for accommodations. All information in this course can be made available in alternative format with prior notification to the Center for Disability Services.