Math 310-Spring 2024
Foundations for Higher Mathematics

Proof: $\sqrt{2} = q/p \implies 2p^2 = q^2 \implies ?\,\blacksquare$

General information

      Class time: MWF 1-1:50pm
      Class location: Simon 023
      Instructor: Greg Knese
      Office hours: Tu 12-1pm, W 12-1pm, Th 10-11am
      Office location: Cupples I Room 214
      Email: geknese at wustl dot edu

Course description

An introduction to the rigorous techniques used in more advanced mathematics. Topics include set theoretic methods of proof, counter-examples, basic logic, foundations of mathematics. Use of these methods in areas such as construction of number systems, counting methods, combinatorial arguments and elementary analysis. Prerequisite: Math 233.

Textbooks

Required:
      1. Discrete Mathematics zybook by Sandy Irani.
      Instructions:
            Go to zybooks.com
            Create an account
            Enter zybook code: WUSTLMATH310KneseSpring2024
            Purchase zybook (should be $64)
            (If you drop the course you should be able to get a refund.)

Recommended:

      2. Transition to Higher Mathematics, Structure and Proof (2nd ed.)
            by Dumas and McCarthy.
            Download here: https://openscholarship.wustl.edu/books/10/
      3. Reading, Writing, and Proving: A Closer Look at Mathematics
            by Daepp and Gorkin
            Available at springerlink.com on campus network
      4. An Infinite Descent into Pure Mathematics
            by Clive Newstead
            Available at https://infinitedescent.xyz/

Course Plan and Goals:

From zyBook: Logic, Proofs, Sets, Functions, Relations, Induction, Integers.
Chapters 5,6,8,9 of the Dumas-McCarthy book (time-permitting)

Goals:

1. Learn the language of mathematics: Learn to read and write rigorous theorems, definitions, and proofs like a mathematician.
2. Be prepared for rigorous math courses such as Math 429 and 4111.
3. Learn and become comfortable with propositional logic, naive set theory, standard constructions pervasive in mathematics (functions, equivalence relations), integers (mathematical induction), cardinality (especially finite vs countable vs uncountable), elementary real analysis and construction of the real numbers, the axiom of choice and equivalents.
4. Learn aspects of math culture and professionalism (writing in LaTeX). Learn to appreciate why we need to move beyond a calculation based mathematics and into a rigorous theory-building mathematics.

Piazza, Canvas, Gradescope, ZyBooks

Outside discussions and logistics will mostly occur on piazza. Please ask math questions on piazza (anonymously if you so choose).

https://piazza.com/wustl/spring2024/sp2024l24math31001

Grades and a few basic things will be posted to the canvas page. mycanvas.wustl.edu

Homework will be turned in via gradescope or will be completed on the course zybook page.

gradescope.com
zybooks.com

Exams

There will be two in-class midterm exams (February 14, March 27) and a final exam.
The final exam is **May 8, 2024, 1-3pm**. The exams will not be overly cumulative but some previous material is inevitable.

Homework

The zyBook has "participation activities" and "challenge activities" that will be assigned before and after each class. You cannot get participation activities wrong. Challenge activities can be repeated until you get them correct.

There will be homework assignments every week or every other week done either through gradescope or the course zybook page.

Written homework solutions should be written up clearly, in detail, and using LaTeX. The easiest way to get started in LaTeX is using overleaf.com. I will introduce LaTeX and overleaf in class and provide templates to get you started on the first homework.

Grading philosophy: We are learning to do rigorous mathematics. Our goal is to write iron-clad logical and understandable proofs. In previous computational math courses, one may receive partial credit for having some idea correct or you may get the benefit of the doubt on certain mistakes. In proof writing, the writer does not get the benefit of the doubt. It is much better to confess that you do not how to write something rigorous than to pretend that you can. Obviously when learning something new you may not have complete awareness of when you are doing something wrong—but the goal we strive for is to attain this awareness.

Collaboration: You may discuss the homework verbally with other students provided you have already given the homework a serious attempt. If you have already solved a problem and someone asks you about it, then any help you provide should consist of hints or suggestions and never complete solutions. In particular, homework should be written up independently and it should not be possible to tell who worked with whom. Do not search or post requests for solutions to HW. Do not post any course materials online. You may always post questions about homework via piazza discussions.

Dropping/Late policy: Your participation grade will be calculated as:

$$\min\{(\text{Percent completed} + 15\%), 100\%\}$$

Meaning, you can safely miss 15% of the participation activities and still get 100%.

Your two lowest homework score will be dropped. This policy is designed to take care of all instances where a student cannot complete an assignment on time so that the instructor does not need to make subjective judgement calls. Late homework and participation activities will not be accepted so that solutions can be posted in a timely manner.

Grade breakdown

       Participation activities (from zyBook): 5%
       Homework (including challenge activities from zyBook): 35%
       Midterm exams: 15%+15% = 30%
       Final exam: 30%
       Letter grade breakdown: A+=(97,100], A=(93,97], A-=[90,93], similar for B,C,D. Finally, F=[0,60).