MTH 243
SYLLABUS
Fall 2005

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THE TOPICS

Countable and noncountable sets, Metrics, Boundedness and completeness in the Reals, Open and closed sets, accumulation points, The Cantor Set, Continuity and differentiability of real-valued functions of a single variable, Sequences of functions, pointwise and uniform convergence, Series of functions, Boolean Algebras and measures on the reals, Riemann and Lebesgue integrals.

THE IDEAS

Introduction to Analysis investigates the structure of the real number system, functions, sequences, series, continuity, differentiation, measure theory and integration. While some of these words might sound familiar to you, I assure you that our investigation will be full of surprises and counter-intuitive examples. That is in great parts why the field of analysis originated.

It is easy enough to think of a continuous function as one whose graph can be drawn without lifting the pencil from the paper, but it turns out that there's a function that's continuous at every irrational number and discontinuous at every rational. There's no way to draw its graph! There's a way to define distance between numbers so that a ball of radius 1 includes the entire real line. We will learn that an integral of a function depends not only on the function but on the measure used to measure intervals. So $\int_0^1 x^2 \mathrm{d}\mu$ might have many different values depending on the measure μ. There are many cases where the fundamental theorem of calculus connecting integrals with derivatives cannot be applied.

THE APPROACH

A goal of the class is to empower you to (re)create and/or (re)formulate mathematics on your own. This, to my sense, is the ultimate way to learn mathematics. But little mathematics is created in entire isolation. Thus another goal in this course is to build the confidence and skills with which to collaborate in mathematics and communicate it.

These goals are the motivation of the unusual structure of this class. Each week you will study a new idea by yourself, discuss it with others on your team, write about it and present it with your team to your classmates. In that way I hope you will discover all the complexity, richness and beauty in the idea, and feel some ownership of the idea.

THE PROGRAM

You will work in teams of three or four. Teams will change twice during the semester. Each assignment will consist of a theorem or two for your team to prove, or examples to explore. It will take a three-class cycle (a week) to complete. The cycle schedule will be roughly as follows: (This illustration assumes the "week" begins on Monday, but the three-day cycle can begin on Wed. or Fri. as well.)

Monday. Get the assignment Monday, work on it *by yourself*. Then meet with your team to discuss it and make as much progress as you can by Wednesday.

Wednesday. Meet with me in a coaching session to explain to me how you solved it, or to get help if you didn't solve it.

Between Wed. and Fri. Prepare *by yourself* a draft of the presentation. (More on the form of the presentation later.) I'll have an office hour to help those who are still having trouble with the problem at this stage.

Friday. Meet in class to exchange drafts with your team members to critique each other's work, and to decide on a final draft, and how you will present the work on Monday.

Between Fri and Mon. One team member writes the final presentation and duplicates enough copies for the entire class (and two for me). [The team must rotate this job every week.] I reserve the right to ask for corrections on this final draft, to be posted on course info.

Monday. Class meeting and presentations.

THE PRESENTATIONS

Each presentation begins with an *abstract*. This is usually written after the presentation is completely written. It tells the reader the essential idea in the paper.

The body of the presentation is written for your classmates. It should present the problem well-stated; then the solution or proof with enough detail so that your classmates can understand and follow, but not with so much detail that it's laborious to read. It's really a skill to write with clarity, conciseness and cogency. That's a skill that you will develop as you write.

It's highly advisable to have access to a mathematics word processor such as TeX (see the latex.pdf file in Course Documents on our blackboard site). It is also possible to download (shareware) TeX programs on Windows and Macs. MS Word also has an equation editor which can type math symbols.

EXAMS

There will be two take-home exams–(individual efforts) The first will be from **Monday Oct. 24 to Friday Oct. 28**. There will be NO CLASS Wed. Oct 26 or Fri. Oct. 28. You will pass in your exam by 2:30 pm Oct. 28 at the Science Center Administrative Office. **This exam schedule may be shifted by one class if Mountain Day occurs during one of our earlier classes.**

The second exam will be from **Friday Dec. 9 to 2:30 pm Wednesday Dec. 14** (the last week of class.) There will be NO CLASS Monday Dec. 12 or Wednesday Dec. 14.

GRADING POLICY

The written and oral presentations will both be graded as follows:
1 = Full credit.
2 = WOW! Not only correct but beautiful. (rarely given. counts as "1")
0 = no credit. Not done or missed the essential point. (In this course that happens very rarely.) If a team gets 0 on a presentation they have one week to get help from me and resubmit it for a passing grade.

All members of a group receive the same grade for each written presentation but individual grades for their parts in the oral presentation.

The written presentations count 15% of your grade (all 1's = A); The oral presentations count 15% of your grade (all 1's = A); The two exams count 70% of your grade–Your best exam counts 40%, your other exam counts 30%; Extra credit is available for those who also work on other groups' assignment. The work can be then hand written.