MATH 433, Abstract Algebra
Fall 2010

Bryan Smith

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Contents

1 Introduction

The only formal prerequisite for this course is Linear Algebra (Math 290). This means you should be familiar not only with the standard methods and techniques for thinking about and solving proof-oriented mathematical problems but also with the basics of developing and writing proofs.

Although there are few prerequisites, Abstract Algebra 433 is a senior level course. Faculty in mathematics consider this course a capstone for those of you pursuing either a career in secondary education or graduate studies in mathematics.

By taking Math 433, you will acquire a deeper knowledge of linear algebra as well as learn the fundamentals of group theory. This latter topic provides an exceptional example of the true power of algebra: take a useful, concrete example and abstract its basic concepts to such a level that the abstraction can be applied to many new situations. In particular, group theory has applications to quantum theory, molecular structure, symmetry (ranging from the structure of crystals to the mathematics describing attempts at "Grand Unified Theories" of everything), coding theory, the structure of complex numbers, the topology of the universe, and much more.

We will cover the material in chaters 0-13 of our text but you should find additional references to use throughout the semester. There are an abundance of useful books in the library and mathematics reading room.

For an official description of this course, see the department's MATH 433 Syllabus[4].

Besides learning group theory, by the time we finish this course, you should also have refined the following skills.

- read a mathematical text for content and deep understanding (see "How to Study" [6] for an excellent description of how to read mathematics and other efficient ways to study),
- analyze a given problem to determine which tools should be used in its solution,
- use a variety of strategies to determine and prove a solution of the given problem, and
- follow accepted mathematical style to present an accurate and carefully written formal proof of your solution.

2 Course Information

2.1 Textbook

The textbook is *Abstract Algebra*, Theory and Applications, Thomas Judson, ©2009, GNU Free Documentation License

We will occasionally use sophisticated computational programs. Since SAGE is open source and is getting easier to use by the day we will use it rather than any of the commercial products. I am also requiring that you use LaTeX for at least one of your "writing" problems. I will show you the basics of using LaTeX early in the semester.

You should already feel comfortable with the standard approaches to constructing a mathematical proof. However, if you would like to have a resource at hand, you might consider buying one of the many books on "how to do proofs". I recommend "The Nuts and Bolts of Proofs".

- "The Nuts and Bolts of Proofs", Antonella Cupillari [7]

2.2 Basic Information

You can find information pertinent to all of my classes at the link below and, once there, information specific to this class by clicking on the Math 433 link.

`http://math.ups.edu/~bryans/` [1]

2.2.1 Logistics

Bryan Smith	TH 390D	879-3562	bryans[at]ups.edu
Math 433	TH 374	M, F	9:00-9:50am
		T, Th	9:30-10:20am
Office Hours		Tue	8:00-8:30am, 10:30-11am, 1:30-2pm, 2-3pm
		Wed	3:00-4:30pm
		Thu	2:00-3:00pm
		Others	By Appointment

2.3 Examinations

Since the homework problems will be used to facilitate deep understanding, tests will be used more as a basic check of your knowledge. Hence, there will be two, "straightforward", semester examinations.

Examination One	Thursday	Sep 30
Examination Two	Thursday	Nov 11

2.4 Final Examination: Wednesday, December 15 at 8:00am

The final will also be "straightforward" and comprehensive. The final cannot be rescheduled so do not plan plane flights (or anything else) that will conflict with it.

2.5 Writing Projects

Many homework problems will be assigned throughout the semester. They represent a selection of the available problems that highlight important concepts, techniques, or computational skills. Most of these problems will not be collected so you are expected to work as many of them as you feel necessary to master the material.

However, 25 problems will be collected and marked. Of these, 20 will be marked for mathematical accuracy. When you present these, you are to assume an audience of your Math 433 peers and provide justifications for every step in your argument that is not clear to this audience.

In addition, over the course of the semester, you are to designate 5 of the 25 problems as "writing" problems which I will mark for both mathematical accuracy and clarity of exposition (see below and my web page for some basic guidelines for writing mathematics). Do not turn in more than one of these writing problems in any week since their purpose is to provide feedback as you develop your mathematical writing style. I expect at least 3 of these problems to be turned in by midterm. **Writing problems may only be resubmitted one time.**

Credit for the other 20 problems is earned when you turn in a complete and accurate solution. If you turn in an incomplete or inaccurate solution, I will make a few comments and return it. You may then re-submit the problem. This process may be repeated. To provide some reinforcement for being timely, you may submit no more than 5 problems per week.

Feel free to use (or not) any technology that you like (e.g., Sage, Scientific Notebook, CABRI, Geometers Sketchpad, calculators, *Mathematica*, MATLAB, etc.). You may also work with others in

solving these problems but there is to be no collaboration (other than consulting with me) in the writing of the solutions. Moreover, you **must** cite each resource you use. Do this in a reference paragraph at the beginning of your paper either affirming the work is completely yours or citing each resource you use: names of participants in discussions (other than the in-class discussions), technological tools, reference texts employed, and anything else other than your own thoughts. Failure to include references is intellectual theft! Please see the "Academic Honesty" section of the *Logger* to see how serious this issue is to the university community.

The "writing" problems are actually the mathematical equivalent of assigned papers in humanities courses. In particular, be sure to invest adequate time in analysis and research before you completely explain that analysis of the problem. You are also expected to follow standard mathematical style in your presentation. The easiest way to see examples of this standard style is to read your textbook. You can also peruse any copy of *Mathematics Magazine* or the American Mathematical Association *Monthly*. You can find copies of these journals in the Mathematics Reading Room, my office or the library. Remember, your "writing" papers will be graded both for mathematical content and for written presentation using the grading rubric on the last page of this document.

2.6 Reading

Developing an ability to read and understand a (relatively) technical piece of writing is a primary goal of this course. This skill is fundamental not only for those who wish a career in science but also for anyone who wishes to be a well-rounded member of society. Hence, careful reading of the texts is an integral part of this course — especially since lectures will not be word-for-word reiterations of the material in the textbook. I recommend multiple readings of the material as we cover it since technical material is difficult to grasp quickly. (See "How to Study"[6] on the course webpage for more details.)

2.7 Course Information Updates

If you wish, I will post (and update) a grade report on your current standing in the class on my university web page. You should keep track of your grades on the various assignments and check them against these reports. If there are any discrepancies they should be dealt with immediately.

To have your information posted you need to print your name, the date, the class (MATH 433), and a code on a sheet of paper. Then sign the paper and physically hand it to me. The code is to be a sequence of up to 23 symbols I can type on a keyboard.

2.8 Total Points

Homework: Normal	50%
Homework: Writing	14%
Examinations	24%
Final Examination	12%

2.9 First Graded Homework Assignment

(Due Wednesday September 1 at 5:00 P.M.)

1. Look over both my university web page `http://math.ups.edu/~bryans/` [1] and the course webpage for MATH 433 you'll find there.

2. Send an e-mail message to me at bryans [at] ups.edu that contains the information below. Make sure the course number, 433, and your name are in the "Subject" line.

(a) Tell me if you have any schedule conflicts on Tuesday or Thursday from 10:30 to 11:am.

(b) Tell me your mathematical plans after graduation.

(c) Tell me which of the suggested techniques in the Rapaport [6] reading seemed obvious to you even though you haven't used them in previous classes.

References

[1] Bryan Smith's Homepage
`http://math.ups.edu/~bryans/`

[2] Math 433A Course Webpage
`http://math.ups.edu/~bryans/Current/Fall_2010/433Index_Fall2010.html`

[3] Department Calculator Policy
`http://www.math.ups.edu/info/calcpolicy.pdf`

[4] Department Syllabus for MATH 433
`http://www.math.ups.edu/~matthews/Syllabi/MA433Syllabus.pdf`

[5] Location of MikTeX package for using LaTeX `miktex.org`

[6] William Rapaport's "How to Study"
`http://www.cse.buffalo.edu/~rapaport/howtostudy.html`

[7] "The Nuts and Bolts of Proofs", Antonella Cupillari
`http://www.amazon.com/exec/obidos/tg/detail/-/0120885093/`

3 Math 433 Writing Projects Grading Rubric

Points	Logic and Mathematics
5	Arguments are correct, complete and without inappropriate material.
4	Arguments have one minor error, omission or inappropriate inclusion.
2	Arguments have two minor errors, omissions or inappropriate inclusions.
0	Arguments are more seriously flawed.

Points	Use of Terminology and Notation
3	All technical terms, concepts and notation are used correctly.
1	Arguments have one lapse in terminology or notation
0	There are significant problems with terminology or concepts.

Points	Written Presentation
3	Is well-written
2	Has one or two minor lapses in style
0	Has more stylistic lapses

3.1 Writing Guidelines

It is best to think of these writing projects as officially assigned papers in which you completely explain and justify your analyses of the problems. You may work with others in solving these problems but there is to be **no collaboration on the written exposition of the solutions.** In addition I expect your papers to be

- Fully documented – specifically:

    1. You must include a reference paragraph at the beginning of your paper either affirming the work is completely yours or listing each resource you use: names of participants in discussions (other than the in-class discussions), technological tools, reference texts employed, and anything else other than your own thoughts.
    2. Any idea obtained during brainstorm sessions or in discussions is cited in-line.
    3. All important textbook results (theorems, propositions, and lemmas) are cited in-line and include the name of the result.
    4. Any use of technology is cited in-line.

- Carefully handwritten in ink or written with a word processor.
- Written using complete, accurately punctuated sentences.
- Presented in active voice, first person plural and with a clear, easy-to-follow expository style.
- Targeted at an audience consisting of students not in this class but with an equivalent mathematical background – say those currently in another section of this course.