

# MATH 704: Senior Seminar Spring 2015

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## Contents

1	Catalog Description	2
2	Course Supervisor	2
3	Purposes of the Seminar	2
4	Schedule	3
5	Plagiarism	4
6	Texts	5
7	Library Assistance	5
8	Thesis Expectations	5
9	Basis for Evaluation	7
10	Typsetting Your Thesis	7
11	How To Give a Good Talk	8

## 1 Catalog Description

### **MATH 0704 Senior Seminar (Fall, Spring)**

Each student will explore in depth a topic in pure or applied mathematics, under one-on-one supervision by a faculty advisor. The course culminates with a major written paper and presentation. This experience emphasizes independent study, library research, expository writing, and oral presentation. The goal is to demonstrate the ability to internalize and organize a substantial piece of mathematics. Class meetings include attendance at a series of lectures designed to introduce and integrate ideas of mathematics not covered in the previous three years. Registration is by permission (and registration is expected to occur during registration period): Each student must have identified a topic, an advisor, and at least one principal reference source. 3 hrs. lect./disc.

## 2 Course Supervisor

John Schmitt

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E-mail: [jschmitt@middlebury.edu](mailto:jschmitt@middlebury.edu)

My (and course) webpage: <http://community.middlebury.edu/~jschmitt/>

Office Hours: Monday 10am–12noon, Tuesday 1:30–3pm, Wednesday 10am–11am or by arrangement

## 3 Purposes of the Seminar

The Senior Seminar in Mathematics has two primary purposes:

1. First, to expose mathematics majors to a number of important and interesting topics in the mathematical sciences that are normally not presented within the department's set of required courses. This goal is accomplished by the series of talks given by visiting mathematicians, members of the Middlebury faculty, and the senior majors.

2. Second, to give majors the opportunity to explore in depth a topic in pure or applied mathematics. This experience emphasizes some aspects of education not normally stressed in our regular courses: independent study, library research, organizing and internalizing a chunk of mathematics, expository writing, and verbal presentation of material. The Senior Seminar requires that each enrolled student participate in an active fashion. **ATTENDANCE AT ALL THE SCHEDULED SEMINAR TALKS, LECTURES AND FILMS DURING THE STUDENT'S THESIS SEMESTER IS DEMANDED: ACTIVE PARTICIPATION IS EXPECTED.** We ask all our speakers to gear their talks to an undergraduate audience so that all student listeners can make sense of what is going on and can learn some mathematics from the presentations.

## 4 Schedule

The following schedule of deadlines will be in effect for Spring Semester, 2015:

Week 1: Inform me of your thesis topic, faculty adviser, and find at least one core reference. Install the appropriate version of L<sup>A</sup>T<sub>E</sub>X on your computer.

Week 2: Give a 5-minute chalk-talk in class on your thesis topic. (**Thursday, February 19**)

Week 3: Submit to thesis adviser and MATH 704 supervisor a bibliography of books, papers, and other references. (**Thursday, February 26**)

Week 4: Give another 5-minute presentation on your thesis topic (**Tuesday, March 5**) and submit outline of thesis to both advisers;

Week 6: Give a 10-minute presentation on your thesis topic using Beamer (**Thursday, March 19**)

Week 8: Submit first draft of thesis to thesis adviser (**Thursday, April 2**)

Week 10: Submit second draft of thesis to thesis adviser (**Thursday, April 16**)

Week 12: Get excited!

Week 13: Submit final draft of thesis to thesis adviser (**Monday, May 4**)

Week 13: Presentation of thesis talks (**Tuesday, May 5 and Thursday, May 7**)

Week 13: Submit polished final thesis to MATH 704 supervisor by 5 PM on **Monday, May 11**. You should hand in three printed copies and one electronic version. **Late Penalties: The department's policy normally requires a minimum penalty of a drop of one grade for each day, or portion thereof, the thesis is late. Thus a thesis which would have been awarded an A based on quality, for example, would receive an A- if the final version is submitted between 5 PM Monday and 5 PM Tuesday, a B+ if submitted between 5 PM Tuesday and 5 PM Wednesday, a B if submitted between 5 PM Wednesday and 5 PM Thursday.**

In addition to weekly class meetings, it is the student's responsibility to meet with the faculty adviser at least once a week.

You should begin with the realization that the senior seminar in mathematics is supposed to be the capstone of your educational experience at Middlebury. It should be your number one priority for the term. In the second half of the semester, large blocks of your time will be devoted to writing your paper.

This schedule requires the student to make an early commitment to a particular topic and to begin work on that subject at the start of the term. You can eliminate some of the last minute all-nighters and panicky final days by disciplined work in the first half of the term. Set a definite period of time each day which you will devote to your thesis. Arrange regular meetings with your adviser at least once a week.

The bibliography, thesis outline, and the first and second drafts will normally be evaluated and returned to the student by the thesis supervisor within one week. The thesis supervisor will read the final draft and indicate corrections which must be made before the polished final thesis is submitted. **The evaluation of how well these course requirements were met will be**

**considered by the Department Faculty in determining the final grade for the course.**

Students sometimes experience difficulty in their first independent learning experience. The structure imposed on you in regular courses – classes meeting two or three times a week, daily homework, scheduled examinations – makes it somewhat easier for you to organize your time and to discipline yourself to meet deadlines. Some of that structure is (deliberately) missing from the Senior Seminar. You will have to take more initiative in organizing your schedule to complete the work on your thesis.

## 5 Plagiarism

The habit of intellectual honesty is essential to both intellectual and moral growth. Effective evaluation of student work and helpful instruction can take place only in an environment where intellectual honesty is respected.

The relevant *Middlebury College Handbook* language is as follows:

“As an academic community devoted to the life of the mind, Middlebury College requires of every student complete intellectual honesty in the preparation of all assigned academic work..”

“Plagiarism is a violation of intellectual honesty. Plagiarism is passing off another person’s work as one’s own. It is taking and presenting as one’s own the ideas, research, writings, creations, or inventions of another. It makes no difference whether the source is a student or a professional in some field. For example, in written work, whenever as much as a sentence or key phrase is taken from the work of another without specific citation of the source, the issue of plagiarism arises.

“Paraphrasing is the close restatement of another’s idea using approximately the language of the original. Paraphrasing without acknowledgment of authorship is also plagiarism and is as serious a violation as an unacknowledged quotation...

“The individual student is responsible for ensuring that his or her work does not involve plagiarism. Ignorance of the nature of plagiarism or of College rules may not be offered as a mitigating circumstance.” [*Middlebury College Handbook 2002-2003*, page 105]

As many theses in our department involve restatements of known theorems and the proofs of the same, the question of plagiarism may be relevant to you. Your thesis adviser will be able to answer any questions you may have about this subject. It is your responsibility to consult with him or her.

It is your responsibility to uphold the Honor Code and adhere to its guidelines on plagiarism for your senior thesis. Sources (books, articles, personal communication) used in the process of your work (including both discussion and proofs of theorems) must be cited, though basic definitions and statements of textbook results need not be. It is not acceptable to reproduce discussion or proof of a mathematical theorem or concept line-for-line, nor is it acceptable to paraphrase. Discussion and proofs in your thesis should be written from your

own understanding of the material. All proofs should be worked through for yourself; guidance from reference sources and/or discussion with others is acceptable, but it must be credited appropriately. *Please take this seriously. Over the past few years charges of academic dishonesty have been brought against a number of Mathematics thesis students!*

## 6 Texts

There are no required texts for the seminar, but we recommend *On Writing Well*, 6th Ed., by William Zinsser as a good general guide to expository writing and the always indispensable (and available from the library as an e-text) *The Elements of Style* by William Strunk and E. B. White.

There are also several excellent short books on the writing of mathematics. These include:

- *How To Write Mathematics* by Norman Steenrod, Paul Halmos, Menahem Schiffer, and Jean Dieudonn,
- *A Primer of Mathematical Writing* by Steven G. Krantz,
- *Mathematical Writing*, edited by by Donald E. Knuth, Tracy Larrabee, and Paul M. Roberts, and
- *Handbook of Writing for the Mathematical Sciences* by Nicholas J. Higham.
- *The Grammar According to West* by Douglas B. West can be found here, <http://www.math.illinois.edu/~dwest/grammar.html>.

A copy of these books will be available on reserve in the Davis Family Library.

## 7 Library Assistance

The College's reference librarians can be of enormous assistance to you – they are good at helping you to identify and locate relevant materials whether in printed or digital format. Contact Bryan Carson (extension 5341), who is the science librarian most familiar with mathematics and computer science materials.

You may also apply at the Circulation Desk at the Library for special senior thesis privileges, such as extended checkout periods, a carrell, or a locker.

## 8 Thesis Expectations

Theses that earn good grades have some of the following qualities in common:

1. *Well presented.* The thesis should have a minimum of typographical errors and misspelled words and be neat and evenly spaced. Take the time to run a spell checker and to proofread. Spelling and grammar do count. Have a friend proofread it for you; new eyes will see mistakes you've missed. Even if

the content is great, you won't get a top grade unless it is also presented in a readable, comprehensible manner.

2. *Relatively difficult mathematics.* You must learn something new, something you did not see in a class, and something with substance. The work does not have to be very broad, but it should be somewhat deep. One option is to take a narrow topic and learn a lot about it. You should understand the topic and be able to explain it in your own words.

3. *Independent work.* You should do most of the learning on your own. Read the material; try to work through proofs by yourself. Feel free to ask questions of your adviser, but do not expect your adviser to present the material to you or to do the proofs for you. If you get stuck, it is perfectly acceptable to ask for hints or for you and your adviser to work through a problem together. Ideally you should combine material from several sources and draw your own conclusions or arrange the material in an original way.

For example, you might pose a problem. Then you could try to work out your own solution (or examples) and/or find several different solutions (or examples) from several different sources. You might discuss the similarities and differences of these solutions: Do they use different types of mathematics? Do you use both number theory and geometry? Can you draw your own illustrations or examples of these methods? Insert some of yourself into your thesis – your opinions, your arrangement of material, your own proofs, or your examples.

4. *Correctness (or accountability).* Check your definitions; be sure that your theorems are correct and that your proofs make sense to you. Can you explain them in your own words? Be very careful that you're not just mimicking someone else's proof and that you really do understand the words you are using.

There is a fine line here between doing your own work and plagiarizing someone else's. If you copy something word for word without using quotation marks (or setting it off in a narrow paragraph) and including a citation, that is plagiarism. Using well established definitions from the literature is not plagiarism, but you must acknowledge your source. It is not acceptable to string together paragraph after paragraph of quoted material. You should be doing most of the writing yourself, using quotations to support a point.

For the expository parts of your thesis, gather the information and then express the ideas in your own words. The definitions can be quoted. The proofs should be, as much as possible, your own. That doesn't mean that you have to prove everything yourself. Working through someone else's proof is a perfectly acceptable thing to do. However, when it comes time to write up your thesis, you should try, as much as possible, to express the ideas in your own words.

5. *Parts completed on schedule.* This means not only meeting all intermediate deadlines, but also holding regular (usually weekly) meetings with your adviser. This is not meant to be a last minute, night before project. This is meant to be a semester long research project. Get each part done on time! Get regular feedback from your adviser. You will need the time available to absorb and understand the difficult concepts. If you understand all of the ideas the first time through, then your problem (project, topic) may not be hard enough.

6. *Appropriate depth and length* Your thesis should delve deeply enough

into the subject area that your analysis requires reasonably sophisticated undergraduate mathematics. Your treatment of the material should be sufficiently extensive to explore the topic thoroughly and carefully, but do not overdo the length. Most theses are between 40 and 60 pages in length. Theses that run longer than 60 pages tend to be hurriedly and awkwardly written. You will need to get permission for your thesis advisor to go beyond 60 pages. The department has set an absolute maximum length of 100 pages for a senior thesis. Your goal should be **Quality**, not **Quantity**.

## 9 Basis for Evaluation

In many departments of the College, a senior thesis is an option available for students seeking Honors in the majors. In our program, all majors are required to complete a one term senior thesis. The distribution of grades in MATH 704 has followed a pattern quite similar to the distribution of grades in other senior level courses in the department. For your information, here is a distribution of MATH 704 grades from 1975 through Spring 2010 (note that A+ is no longer an available grade):

Grade	Number	Grade	Number
A+	12	C+	34
A	91	C	16
A-	117	C-	9
B+	125	D	9
B	86	F	1
B-	53		

Keep in mind that each year the department awards the Dr. Francis D. Parker, '39 Mathematics Prize. The award was established in 1993 by Dr. Francis D. Parker, class of 1939. It is awarded to the graduating student for the best senior work in the mathematics department and is largely based upon the senior thesis, though other accomplishments (Putnam scores, Green Chicken scores, conference participation, etc.) are considered as well.

## 10 Typsetting Your Thesis

After a highly successful experiment in Fall 2005, the Mathematics Department decided to require that all seniors compose their theses using  $\text{\TeX}$ .  $\text{\TeX}$  is a typesetting system created initially in the late 1970s by Stanford mathematician and computer scientist Donald Knuth. Knuth designed  $\text{\TeX}$  to allow any individual to produce high-quality typeset books and articles using a reasonable amount of effort, and to provide a system that would give the exact same results on all computers, now and in the future.

$\text{\TeX}$  is generally considered to be the best way to typeset complex mathematical formulas, but, especially in the form of  $\text{\LaTeX}$  and other template

packages, is now also being used for many other typesetting tasks.  $\LaTeX$  offers programmable desktop publishing features and extensive facilities for automating most aspects of typesetting and desktop publishing, including numbering and cross-referencing, tables and figures, page layout, bibliographies, and much more.  $\LaTeX$  was originally written in 1984 by Leslie Lamport and has become the dominant method for using  $\TeX$ . Few people write in plain  $\TeX$  anymore.

Software packages that incorporate  $\LaTeX$  and  $\TeX$  are widely available on the web and are free of charge. We recommend MikTeX for Windows users and TeXShop for Macintosh users. We will distribute CD's with the requisite software or provide detailed directions on finding and downloading what you need to install.

Several books on using  $\LaTeX$  have been put on one-day reserve at the library. They are:

- *Learning  $\LaTeX$*  by David Griffiths and Desmond Higham. I highly recommend you purchase a copy.
- *A Guide to  $\LaTeX$ : Document Preparation for Beginners and Advanced Users* by Helmut Kopka and Patrick Daly.
- *The  $\LaTeX$  Companion* by Michel Gossens, Frank Mittelbach, and Alexander Samarin.
- *First steps in  $\LaTeX$*  by George Grätzer.
- *$\LaTeX$  : a document preparation system: user's guide and reference manual* by Leslie Lamport.

Professor Swenton has prepared several templates for use with  $\LaTeX$  that will make it easy for you to begin composing your thesis. These are to be e-mailed to you.

## 11 How To Give a Good Talk

Joe Gallian has written a short but perceptive article giving very practical suggestions for giving mathematical talks. His article follows.