MATH 100B: INTRODUCTION TO ALGEBRA PART II
SPRING 2015

Instructor: Arunima Ray
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Course website: http://people.brandeis.edu/~aruray/teaching/100bS15
Lecture Time: TF 11a–12:20p (Block H)
Office: Goldsmith 205
Office Hours: M 5-6p (and onwards), Th 11a-12:30p, and by appointment.

Textbook:
Abstract Algebra, by David Dummit and Richard Foote (third edition).
Errata at http://www.cems.uvm.edu/~rfoote/errata_3rd_edition.pdf

Additional References:
The following are *not* required. They are simply for you to look up in case you are seeking additional resources.

First Course in Abstract Algebra, by John B. Fraleigh
Algebra, by Michael Artin
Galois theory, by Ian Stewart

Prerequisites:
MATH 100a or permission of the instructor. May not be taken for credit by students who took MATH 30b in prior years.

Course outline:
In terms of content, we will cover three main topics: rings, modules (and vector spaces), and fields (including Galois theory), corresponding to Parts II, III, and IV of Dummit and Foote.

A substantial part of the job description of a professional mathematician is disseminating one's work – by publishing papers and by giving talks. In this course we will work on the skills needed for this. We will get started by focusing on writing complete coherent sentences in problem sets, and through short in-class (mathematical) presentations. At the end of the semester, each student will give a final presentation, accompanied by a final paper, on an algebra topic of their choice.

Feedback:
Occasionally during the semester I will pass out notecards asking for (anonymous) feedback. Please use them to share any thoughts or concerns regarding the course. Remember, the sooner you tell me your concerns, the more I can do about them. In addition, you can send me anonymous feedback through the google form available at http://goo.gl/forms/HUhQaWRDXk (this link can also be found on the course website). To make sure only members of this class use this form, we have a codeword, which will be announced on the first day of class; **our code word is** _____.

LATTE:
Course materials and grades will be available on LATTE. Log in at `http://latte.brandeis.edu` using your Unet username and password.

Grading: Your grade will be determined as follows.

Problem sets:	30%
In-class presentations (3) and feedback:	10%
Midterm (take-home):	15%
Final (take-home):	20%
Final paper, presentation and presentation feedback:	15%
Seminar reports (2):	10%

If there are any concerns about grading, please see me within one week of getting the assignment/exam back, and before the last day of class (April 28).

Problem sets:
There will be *five* problem sets throughout the semester, each worth 5% of your final grade. Please feel free to work with one another on the problem sets; however, your solutions must be written independently and you should note down the names of who you have worked with on the first page of your problem set. You are not allowed to look up solutions online (until you have submitted your work).

Writing is a huge part of a professional mathematician's life. As a result, your problem sets (and exams) will be graded for exposition as well as mathematical content.

Problem sets are due at the end of the class period on the due date. Each late day will lead to a $\frac{1}{7}$ deduction in your grade, i.e. if the problem set is worth 70 points and you submit a day late, I will subtract 10 points from the score you earn. I will not accept problem sets that are more than a week late; however, you are welcome to come to office hours and discuss your problem set even if you cannot turn it in for credit.

In-class presentations and feedback:
Each student will give three in-class presentations during the course of the semester, corresponding to the three major parts of the course - rings, modules, and fields (see schedule at the end of this syllabus for dates). The presentations will be short (5–10 minutes); presentations will be about a result or topic from the book and will be assigned at least a week ahead of time. You are welcome to swap times/topics with others in the class as long as you let me know ahead of time.

You will also be responsible for filling out feedback forms for your peers during their in-class presentations; these are part of your in-class presentation grade! Your feedback will be given to your peers after removing your name/identifying information.

The in-class presentations are meant to be a way for your to practice your public 'math-speaking' skills before having to give the final presentation. You will receive feedback from your peers, as well as from me after each in-class presentation.

Exams:
There will be two exams in this course: a midterm and a final. Both will be take-home. Both will be graded for exposition as well as mathematical content.

Final paper and presentation:
The final paper and presentation will be on a topic of your choosing. The topic may be something from our textbook that we have not covered. Or it can be on anything else in the wide world of algebra – not necessarily related to anything we have done this semester. If there is something that you have always wished to know more about, and it happens to be somewhat algebraic, this is your chance to read up on it! It can be an application of something we have learned, a theorem that you find interesting, an example that was unexpected to you, etc. In case you are unsure of where to start, here are some example topics off the top of my head:

- Sylow theorems
- The Monster group, sporadic groups
- Zorn's lemma and the axiom of choice
- Dedekind domains
- Groupoids, semigroups, monoids, magmas, ...
- Algebras, Lie algebras
- Tensor products, exterior products
- Semi direct products
- Group actions
- Fundamental group
- Algebraic coding theory
- Categories and functors
- Elliptic curves
- Algebraic geometry
- Hilbert's nullstellensatz
- Representations
- Localizations
- Hilbert's basis theorem
- Cayley graphs

Find these on wikipedia, or google them, and click on interesting things - this will probably help you find a topic you like.

Topics are due to me, via email, on March 10. If you are unsure of a topic, please feel free to ask me for suggestions. I will be happy to work with you to find something relevant and interesting.

Once your topic has been approved as being appropriate (and I have made sure that there are no duplicate topics), you should start working on your paper. Papers will be **expository**, in the sense that you are not required to create new mathematics; you should be summarizing your chosen topic, with citations as needed. You may use just one source, although it is probably better to find multiple sources. Pretend that you are writing a chapter in a book—so, if you are writing about say, integral domains, you should include a definition, give examples, include some interesting results, etc.

Your paper need not be double spaced. The font size should be between 11 and 12pt. It **cannot be longer than seven pages**, including any figures, references, etc. Five pages is a reasonable length to aim for. Your papers must be typed. While you are welcome to use any typesetting software (Microsoft Office, OpenOffice, etc.), you should consider the LaTeX document preparation system, particularly if you are interested in graduate school, mathematics or otherwise. LaTeX is excellent at dealing with mathematical symbols; it is the

system used to write roughly all mathematical papers and books these days (including this syllabus). For information about LaTeX see here: `http://en.wikibooks.org/wiki/LaTeX`.

You should write your paper and plan your presentation keeping in mind your audience – namely, your fellow students in class.

The first drafts of your papers will be due to me on March 31, although you may hand it in earlier in you wish. I will return the drafts to you, with comments, on April 14. Your final papers will be due to me in class on April 28.

In addition to the final paper, each student will give a final presentation (on the same topic). Presentations will be 20 minutes long, and will be given in class, on the last few days of the semester. As with the in-class presentations, students will also give feedback on presentations. (Giving feedback will count as part of your grade.) Feedback forms will be given to the speakers after removing names/identifying information.

You are welcome to work with your classmates on your final paper and presentation, but your write-ups must be your own. You are of course welcome to come talk to me as well. In addition, you are welcome to look up `http://math.stackexchange.com` or any other online resources.

Seminar reports:
During the semester, you should attend two seminars in the mathematics department, and submit a short report. I recommend the Everytopic Seminar; see website here:

`http://people.brandeis.edu/~bernardi/everytopic/everytopic.html`

If you have a particular strong background in the relevant subject, e.g. if you have taken a graduate-level course in it, you may choose to attend the Combinatorics seminar, Topology seminar, or the joint Brandeis-Harvard-MIT-Northeastern colloquium; see here:

`http://www.brandeis.edu/departments/mathematics/talks.html`

If you have a schedule conflict with the Everytopic seminar, let me know, and we will find a different way for you to fulfill this requirement.

The report should be less than one page long. It should include the title of the talk, and the name of the speaker. It should include some of the things you learned in the talk. If you like, you may include a critique of the speaking style of the speaker, but this is not necessary.

Expectations:
This is a higher-level pure mathematics course. As a result, you should expect to do a fair amount of independent reading, and much of our work will consist of reading and writing proofs. I expect you to do readings and homeworks in time. I expect you to ask questions in class or in office hours if you have them.

In return you should expect me to be on time for lectures, be available in my office for scheduled office hours, and respond to emails in a timely manner. You should also expect me to answer your questions to the best of my ability, and to direct you towards appropriate

resources when necessary. You should expect my goal to be for everyone in this class to do well.

Schedule:
Any changes to the following will be mentioned in class.

Jan 13	First day of class
Jan 16	
Jan 20	
Jan 23	
Jan 27	
Jan 30	PS #1 due, In-class presentation day
Feb 3	
Feb 6	
Feb 10	PS #2 due
Feb 13	In-class presentation day
Feb 16	*Midterm recess*
Feb 20	*Midterm recess*
Feb 24	
Feb 27	
Mar 3	PS # 3 due, midterm handed out
Mar 6	
Mar 10	**Midterms due**, paper topics due
Mar 13	
Mar 17	PS # 4 due
Mar 20	In-class presentation day
Mar 24	
Mar 27	
Mar 31	First draft due for final paper
Apr 3	*Good Friday*
Apr 6	*Passover and spring recess*
Apr 10	*Passover and spring recess*
Apr 14	Paper drafts returned with comments
Apr 17	PS # 5 due
Apr 21	Final presentations start
Apr 24	Final presentations continue
Apr 28	**Final papers due**, final presentations continue, finals handed out, last day of class
May 6	**Final exams due**

Disability support: If you are a student with a documented disability on record at Brandeis University and wish to have a reasonable accommodation made for you in this class, please see me immediately.

Academic Integrity: You are expected to be familiar with, and to follow, the University?s policies on academic integrity. Please consult Brandeis University Rights and Responsibilities for all policies and procedures. All policies related to academic integrity apply to in-class

and take home projects, assignments, exams, and quizzes. Students may only collaborate on assignments with permission from the instructor. Allegations of alleged academic dishonesty will be forwarded to the Director of Academic Integrity. Sanctions for academic dishonesty can include failing grades and/or suspension from the university.

Disclaimer: I reserve the right to make changes to this syllabus and to course policies during the semester. Such changes will be announced in lecture and/or by email when they are made. A copy of this syllabus will be available on my website and will be kept up to date.

Last updated: January 29, 2015