General Course Information

Introduction to Modern Algebra – MATH 310

Fall 2015

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Class: (T, Th) 9:50-11:15 in Siena Hall 117

Course Description
This course is an IBL introduction to Abstract Algebra via the Theory of Groups.

What is IBL? (The following largely was taken from http://www.inquirybasedlearning.org/?page=What_is_IBL)

Inquiry-Based Learning (IBL) is a student-centered method of teaching Mathematics. At the college mathematics level one of the forms of IBL is the Modified Moore Method, named after R. L. Moore. Other forms of IBL are also recognized, which employ different course structures, including some group work, projects, and courses that are not theorem-proof based (e.g. statistics, courses for preservice teachers).

Boiled down to its essence IBL is a teaching method that engages students in sense-making activities. Students are given tasks requiring them to solve problems, conjecture, experiment, explore, create, and communicate... all those wonderful skills and habits of mind that mathematicians engage in regularly. Rather than showing facts or a clear, smooth path to a solution, the instructor guides and mentors students via well-crafted problems through an adventure in mathematical discovery. Key components across effective IBL courses are (a) deep engagement in rich mathematical activities, and (b) opportunities to collaborate with peers (either through class presentations or group-oriented work).

E. Lee May, Salisbury State University, defines IBL:
Inquiry-based learning (IBL) is a method of instruction that places the student, the subject, and their interaction at the center of the learning experience. At the same time, it transforms the role of the teacher from that of dispensing knowledge to one of facilitating learning. It repositions him or her, physically, from the front and center of the classroom to someplace in the middle or back of it, as it subtly yet significantly increases his or her involvement in the thought-processes of the students.

A typical day in an IBL math course is hard to define, due to the variance across the environments and needs at institutions across the nation and world.

Here is a model of a typical day in our IBL math course:

- Class starts
The instructor passes out a signup sheet for students willing to present upcoming problems. The bulk of the time is spent on student presentations of solutions/proofs to problems.

Students, who have been selected previously or at the beginning of class, write proofs/solutions on the board.

One by one, students present their solutions/proofs to their class.

The class as a group (perhaps in pairs) reviews and validates the proofs. Questions are asked and are either dealt with there or the presenter can opt to return with a fix at the next class period.

If the solution is approved as correct by the class, then the next student presents his/her solution. This cycle continues until all students have presented.

If the class cannot arrive at a consensus on a particular problem or issue, then the instructor and the class devise a plan to settle the issue. Perhaps new problems or subproblems are written on the board, and the class is asked to solve these. Teaching choices include pair work immediately or asking students to work on the new tasks outside of class, with the intention of restarting the discussion the next time.

If a new unit of material is started, then a mini lecture and/or some hands-on activities to explore new ideas and definitions could be deployed.

If no one has anything to present OR if everyone is stuck on a problem, pair work or group work can be used to help students break down a problem and generate strategies or ways into solving a particularly hard problem.

**Learning Goals**

This course most directly addresses [Siena learning goals 1, 2 and 3](https://example.com). We see goal 1 because mathematics in general is concerned with clear and logical reasoning, which is the cornerstone of measured judgment. We observe goal 2 because of the necessity of students clearly presenting their findings in language, although rhetoric here isn’t quite the point but clarity and economy of language which is separate from logic. We treat goal 3 because of the architecture of our course requires the humane help of each other through the difficulties of learning a hard subject; mathematics brings many students to the edge of their learning ability, leading to careful reflection on how we learn about and understand our world.

Regarding the learning goals of the School of Science, this course most directly deals with goals A and C found [here](https://example.com). We include goal A, since application of method and problem solving are essential to the course, and goal C because of our emphasis on presentation of solutions.

Regarding the learning objectives of the Mathematics Department, this course most directly speaks to objectives 3 and 5 found [here](https://example.com). These are the ability to communicate mathematical ideas with clarity and coherence through writing and speaking; and the ability to make conjectures and prove propositions within the axiomatic structures of mathematics.

**Course Goals:** After successfully completing this course, a student will be able to:

1) Consider precisely the language of an abstract definition.
2) Recognize the fundamental algebraic structure of a group using the group axioms, and give several explicit examples of groups.
3) Prove basic properties common to all abstract groups.
4) Employ and often prove theorems about subgroups, product groups and quotient groups.
5) Identify generators of finite cyclic groups
6) Exhibit some understanding of the concepts of homomorphism, isomorphism and kernel.
7) Use the classification theorem for finite abelian groups.

Course Materials
The text for this course is Distilling ideas: An introduction to mathematical thinking by Brian Katz and Michael Starbird (ISBN 97816144446132)

Means of Assessment
In this class, assessment is intertwined with instruction and is easy to remember: For a “C” you must present 30 problems, for a “B” you must present 60 and for an “A” you must present 90. So it’s “30-60-90”. This is discussed in detail below.

In this course students embark on a mathematical journey through a craggy landscape with many pitfalls. To avoid missteps it is essential to monitor student work more closely than in a typical course. For this reason, the sole assessment for the course is my personally checking each student’s understanding of every one of their completed problems. Please read the following carefully, as it describes precisely the process by which students will be awarded credit in the course.

When a student is ready for me to check a completed problem I will sit with the student and listen to his or her explanation of a proof or solution either in class or during scheduled office hours. I will continue to read until I find an error in reasoning or calculation, or in the case of a written solution until the writing is too unclear, at which point I will stop and indicate where I stopped. I will give the student a hint and then move on to check another student’s work. After reading a written proof I will often ask the student to describe his or her solution informally, sometimes without looking at what he or she has written, to ensure there has been no plagiarism. In the event that a write-up is perfect but the explanation does not indicate that the student has understood what he or she has written (e.g. has copied a solution from the internet) I reserve the right to award a zero for that problem. If I decide that many students have used overly similar language in their respective written solutions to a problem, I reserve the right to award the grade of zero for that problem for all students who have used the offending language. Once a zero is awarded in either of the above circumstances, it means that a student will not have the opportunity to make up the work for that problem. (The best way to guard against zeros is to talk with one another about the mathematics but not to directly borrow language from one another or look at what each other has written.) No further disciplinary action will be taken for plagiarism than the above, since mathematical writing is very precise and learning about what constitutes mathematical plagiarism is challenging because of the need for solutions to be very precise. One should regard learning not to plagiarize mathematics as a minor additional subgoal for the course. In the event that a student successfully completes a problem, I will award that student credit for that problem. When this happens, the student will have an opportunity to present another problem. Of course,
unless you are awarded a zero for a problem you will have opportunities to present the problem only limited by time constraints.

Let me be absolutely clear about this: I do not promise to spend equal time with every student during class. More time will be spent with students who have worked very hard to write clear solutions to their problems. Such students will have the opportunity to present “runs” of problems to me and thereby may earn a better grade in the course. It is in your best interest to work hard to clarify your ideas before trying to present them!

There are no exams in this class. Your grade for the course is determined as follows: You must be awarded credit for at least 30 problems to guarantee a course grade of C, at least 60 problems to guarantee a grade of B and 90 problems to guarantee a grade of A. Plus or minus grades will be given at my discretion, understanding however that the above “lower bounds” will not be violated by the award of a minus grade, e.g. I will not give a “C-” to any student who has completed at least 30 problems and attends the class each day throughout the semester. In order to be awarded any of the above grades you must continue to attend class every day and work on problems, it is not acceptable to get the grade you want and then stop coming to class. If a student is habitually and regularly absent from class, then the above agreement for a minimum grade is null and void. In the event that I do not take formal attendance for the class, “habitual and regular” absence will be determined at my discretion, and will be gauged by how long it has been since I have seen a student in class or how long it has been since that student has presented a problem for credit.

I will not consider your solutions to problems after the last scheduled day of classes, which is December 14, 2015.

Below is a short rubric to explain the criteria I am using to gauge your understanding, so you can better prepare your solutions:

The major goal of the student is to establish solid command of the concepts and techniques of the course. Such solid command is demonstrated by the student’s ability to solve a problem or prove a theorem correctly and then organize the solution to a problem or proof of the theorem for communication in a clear, correct and concise way. Most of the effort in the course will be devoted to helping students produce what we will call solid solutions to the problems they encounter in the course. The rubric for determining the status of a student’s solution is as follows:

**Flimsy (D-F level):** This is the starting place for many solutions. The solution doesn’t hang together well at all. Language is being misused, basic questions can’t be answered, logic is being violated. The solver can’t explain what happens in the case of basic examples. There is evidence that the solver hasn’t spent enough effort to explore the problem thoroughly enough. The tools that are being used may even be grossly inappropriate for the task. Finally, though, the argument is wrong and for some fundamental reason can’t be fixed.
Rough (C level): The overall idea of what is going on is coming into view with a rough solution. The solution is still wrong as is, but the overall strategy is appropriate and the plan for the solution has promise that it can be made to work. The solver has worked out what happens for some simple examples to check their understanding of the question. Many details still need to be fixed or filled in, and the crucial technical hurdle of the solution still has a gap.

Better (B level): Save for a few minor errors, the solution is complete. Unfortunately, it is not organized clearly enough to be entirely confident in the whole proof at a glance, even though the steps individually check out. The proof also may contain unnecessary steps or be unduly baroque. A long, complicated argument with many twists and turns would be unfortunate to rely on if a simpler one were available nearby!

Solid (A level): As the name suggests, we can be confident that the proof is correct. It is stated in as clear a way as is possible, avoiding extraneous detail but including every necessary one. It is possible to see the overall structure of the proof and its logic at a glance.

The process described above in the section “What is IBL?” will be used to move the status of one of your solutions from Flimsy to Solid. The solution must survive the scrutiny of, and receive the support and consideration of, the rest of the class and me in order to be deemed Solid. This can take time, and so it will not be possible or acceptable for you to “make up ground” at the end of the course by coming to extra office hours or taking an inappropriate amount of time from class to improve several of your solutions from earlier on which you didn’t put in the effort to improve at the beginning. You are expected to keep up. Even though I’ve said this, it’s nothing to worry about if one of your early proofs comes up Flimsy since you can keep working on it and improve it all the way up to Solid, provided you work hard and fix it in a timely manner. In fact, the passage from Flimsy to Solid is most often the way proofs develop. It’s a process!

Expectations

1) You are expected to treat others with respect and concern.

2) You are expected to participate.

3) You are expected to come to class prepared. In this course there will be some assignments that will require your to work out of class.

The thoughtful and sensitive critique and support you provide for your classmates is an important part of our learning experience.

Academic Integrity Policy

If you cheat, it will be reported. The Siena Committee on Academic Integrity hears cases of alleged academic dishonesty. This student/faculty committee reviews evidence for and
against the accused. If the student is found guilty, the committee will determine the appropriate sanction(s), which may include failure of the course, suspension from the College, or permanent dismissal. A statement of the reasons for such sanctions will be placed in the student’s file. Alleging ignorance of what constitutes academic dishonesty or of the College’s policy on the subject will not be considered a valid explanation or excuse.

**Accomodations Policy**

Students with disabilities must register with the Office of Services of Students with Disabilities: http://www.siena.edu/pages/2759.asp. Once registered, accommodations will be made via communication of the above office with the instructor.

**Emergency Policy**

In the event of an emergency, see [http://www.siena.edu/pages/2887.asp](http://www.siena.edu/pages/2887.asp), class will be cancelled, and further instruction will be given by e-mail from the instructor to students, determining the course of action. If possible, the class will carry on virtually via online assignments and readings. In more detail:

(a) You are instructed to bring all texts and a copy of the syllabus/course schedule home with you in the event of a College Closure. The Academic Calendar will be adjusted upon Reopening; so be prepared for the possibility of a short mini-semester; rescheduled class/exam period; and /or rescheduling of the semester, depending on the length of the Closure.

(b) If your situation permits, you should continue with readings and assignments to the best of your ability, per the course schedule.

(c) You will be given instructions regarding how to deal with paper assignments requiring library or other required research by me, as needed.

(d) Online office hours will be used by me in order to maintain contact with my students. You will be able to "check-in" with questions that you have. If you do not have internet access available, I will also provide my home phone number and home address, as needed. Remember, internet, mail delivery, and telephone services may also be impacted by a Pandemic or other emergency event.

(e) Finally, stay connected with information regarding the status of the College's status and Reopening schedule by monitoring the Siena

**Attendance Policy**
Attendance is mandatory in this course. However, documented absences don’t count as absences in this course. A documented absence is: an absence I have excused, a documented illness, a documented athletic department trip, a documented field trip for another course, or a documented family emergency.