

# Abstract Algebra with extension

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## *Course Description*

*Dr. Olympia Nicodemi and Dr. Patrick Rault*

*Math 330 and 388, Spring 2012*

*MWF, 9:30-10:45am*

Innovative course extension: Dr. Nicodemi and Dr. Rault are co-teaching this 4-credit version of our standard 3-credit Abstract Algebra course. To enroll, students must sign up for *both* for the 3-credit Math 330 (Abstract Algebra, section 1, CRN 50634, with Nicodemi and Rault) and the 1-credit Math 388 (Abstract Algebra Extension, CRN 55518). For all purposes (grading, class structure, etc), these two classes will be considered as one cohesive 4-credit class.

Catalogue description: A study of the basic properties of groups, rings, and integral domains, including the fundamental theorem of group homomorphisms. The concepts basic to the development of algebraic systems are studied initially. In addition, students will engage in active problem solving, in teams and as individuals so as to produce proofs and arguments with increased understanding and rigor.

Prerequisites: Math 222, 233, and 239.

Credits: 4 (3 from Math 330, 1 from Math 388).

### Inquiry-Based Learning:

This course involves a high degree of inquiry-based active-learning, which emphasizes **doing mathematics** over learning content. The extra hour will allow you to find time to express and develop your work within the community of the class. The extra time will create a relaxed, fun, and enjoyable environment. Lecturing will be held to a minimum.

The key difference from traditional offerings will be as follows. Students will anticipate each class by preparing basic materials. The class will be spent in discussion and bringing nuance to the prepared material. The students can then RETHINK the issues—concepts and proofs—to hone these ideas and receive feedback from classmates and instructors in class.

A recent research study<sup>1</sup> about the growing nationwide trend toward Inquiry Based Learning (IBL) courses states that it “benefited students in multiple, profound, and perhaps lasting ways. Learning gains and attitudinal changes were especially positive for groups that are often under-served by traditional lecture-based approaches, including women and lower-achieving students [...] Yet there was no evidence of negative consequences of IBL for men, high-achieving students, older and more experienced students: these groups too made gains greater than their non-IBL peers.”

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<sup>1</sup> Assessment & Evaluation Center for Inquiry-Based Learning in Mathematics (2011). *Evaluation of the IBL Mathematics Project: Student and Instructor Outcomes of Inquiry-Based Learning in College Mathematics*. (Report to the Educational Advancement Foundation and the IBL Mathematics Centers) Boulder, CO: University of Colorado, Ethnography & Evaluation Research.

### Who would benefit from this course?

1. Those who want or need practice speaking about mathematics to an audience of their peers, e.g. prospective teachers or professors, or those planning to pursue a career which includes public speaking.
2. Those who have difficulty with proofs and want to go back to the basics to improve their fundamental proving skills.
3. Those who are comfortable with their proving skills and want to step somewhat beyond the usual assignments by creating their own theorems and discovering proofs for the main theorems of the class.
4. Those who wish to experience mathematics and get a small taste of what mathematics research is: make and prove conjectures, write your own theorems and lemmas, and think creatively outside the box.
5. Non-majors who want a taste of upper level mathematics in one elective.

### Grading:

Written homework, student contributions in class (based on quality, not quantity), and exams will all be graded in this class. Students will receive the same grade for Math 330 as for Math 388.

### Alternatives:

Dr. Friedland is offering a traditional 3-credit Abstract Algebra course this Spring on the usual topics of abstract algebra intended for students more comfortable with the usual lecture-based format.

Abstract Algebra is also offered every semester, frequently with two sections offered during the same semester.

Other Inquiry Based Learning (IBL) courses are also offered by various professors in the mathematics department. Dr. Rault will be teaching Introduction to Mathematical Proof (Math 239) in an IBL style this Spring.

### Learning objectives:

- Understand the properties implied by the definitions of a group and rings.
- Understand and use various canonical types of groups (including cyclic groups and groups of permutations) and canonical types of rings (including polynomial rings and modular rings).
- Understand subgroups, normal subgroups and quotient groups.
- Understand ideals and quotient rings.
- Understand and use the concepts of isomorphism and homomorphism for groups and rings.
- Produce rigorous proofs of propositions arising in the context of abstract algebra.
- Successfully work at problem solving via practice in unraveling abstract definitions, creating intuition-forming examples or counterexamples, and prove conjectures. Broadly speaking, students are expected to gain an understanding of what mathematics research is.
- Skill in giving and critiquing presentations. Increased comfort in discussing mathematics.
- Written communication of the solution of a mathematical problem via proof, with each step following from previous steps. Students will understand and produce rigorous arguments (proofs) centered on the material of abstract algebra.