Mathematics 412 Winter 2006

Introduction to Modern Algebra for Teachers

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Web page: `http://www.math.washington.edu/~palmieri/Math412/` or
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Text book: *Integers, Polynomials and Rings* by Ronald S. Irving.

Examinations and grading: There will be one 50-minute midterm on Monday, February 6, and a final exam on Monday, March 13, 2:30–4:20. The tests will be closed-book, in-class exams. The midterm is worth 20% of the grade and the final is worth 30%. There are four homework assignments, due January 20, February 3, February 24, and March 10. The homework is worth 35% of the grade. Writing assignments are worth 5%, and class participation is worth 10%.

Homework grading: Each homework problem will be scored from 0 to 10. The group totals on the four assignments become each member's homework total. If on Assignments 1–3 your score on a problem is less than 7, your group can redo the problem and hand it in again. We will grade this redo, and the score you obtain on the redo will replace the initial score.

Writing: There are three writing assignments for this course. The first is due on Monday, January 9: write a letter to someone (whoever you want: me, yourself, a friend, a famous mathematician, whoever), telling them what you got out of Math 411, what you hope to get out of Math 412, what worked well for you in Math 411, and what you need to improve in Math 412. The second is due on Friday, February 10: write another letter (to the same person or to a different person), discussing how the quarter is going so far. The third is due on the last day of class, Friday, March 10: write a letter about some aspect of the Math 411–412 experience. You might discuss whether the course seems well-designed for potential high school math teachers. You might discuss your favorite piece of mathematics from the course. You might do something else. These letters won't be graded or evaluated – if you turn them in on time, you will get full credit for them.

Tests: The class day prior to each exam will be spent on preparation for the exam. On that day (or perhaps earlier), I will hand out a practice exam that will be a near duplicate of the one you will actually see a few days later. This will allow you as a group to work on the exam material together. You will write the exam individually and be graded individually. (The actual exam will differ from the practice one in minor ways.)

Plan for the course, classroom format: These are the same as in Math 411 last quarter. In order to save paper, I am going to omit the details; see the course web page for a full description.

Assignments

I have highlighted some of the exercises. These are important either historically, mathematically (in the big picture), or mathematically (for this course in particular) – usually all three. Each of you should make sure you understand how to do these.

Assignment 1: polynomials and roots. Due **January 20**.
Reading: Chapter 9, 10.1, 10.2, 10.7, and skim 10.4
Exercises: 9.1–9.6, 9.8–9.13, 10.1–10.10, 10.37, 10.38
Comments: For many of these problems, you're re-doing for polynomials what we did for integers before, so if you get stuck, look at the corresponding proof for integers for a possible source of inspiration. It is also a good idea to understand the similarities as well as the differences in the two settings: integers versus polynomials.

For a slightly different approach to problem 9.6, imitate the book's outlined solution of Exercise 5.3.

Exercise 10.38 will be useful throughout this course when dealing with products of polynomials.
Highlights: 9.2, 9.3, 9.12, 10.1, 10.7, 10.38.

Assignment 2: rational polynomials and polynomial rings. Due **February 3**.
Reading: Chapter 11, Chapter 12
Exercises: 11.1–11.2, 11.4–11.7, 11.11–11.20, 12.1–12.10
Comments: Eisenstein's criterion shows that the polynomials in exercises 11.7–11.10 are irreducible, and you should probably check this. Chapter 12 is your chance to learn about the Euclidean algorithm and the fundamental theorem of arithmetic, if you missed them the first time around.
Highlights: 11.6, 11.11, 11.16, 12.1, 12.2, 12.4, 12.10

Assignment 3: quadratics, congruences. Due **February 24**.
Reading: Chapter 13, 14.1–14.2
Exercises: 13.1–13.2, 13.4, 13.6–13.7, 13.8 (for $p = 3, 5, 7$), 13.9–13.11, 13.12 (for $p = 3, 5, 7$), 13.14–13.21, 14.1–14.4, 14.5 (part 2), 14.6, 14.7 (parts 2, 4), 14.8–14.9, 14.11–14.12
Comments: It's a good idea for each person to work on at least one of Exercises 13.14–13.18, 13.20–21. Exercise 13.13 is interesting, but a bit peripheral to where we're heading.
Highlights: 13.2, 13.9, 13.11, 13.18.

Assignment 4: congruence rings, Euclidean rings, Gaussian integers. Due **March 10**.
Reading: 14.3–14.5, Chapter 15, Chapter 16
Exercises: 14.13–14.18, 14.21–14.25, 15.3–15.9, 15.10 (part 1 only), 15.11, 16.1–16.6, 16.8–16.13
Comments: For part 1 of Exercise 15.10, you should think about it very carefully, but there isn't much to actually write down for a solution. For Exercise 15.11, focus on the second sentence. You may use the result of Theorem 16.7 in any exercise, even though we're skipping the proof.
Highlights: 14.17, 14.24, 14.25, 15.6, 15.7–15.8, 15.9, 15.10, 16.5, and pretty much all of the exercises in section 16.2