
COURSE INFORMATION
MATH 5281 – Fall 2007
Advanced Topics in Algebra

In this reading course we shall look at advanced topics in ring theory. This course can be viewed as a continuation of Math 2231 - Ring Theory. This is a full year course – the second part of the course (on Group Theory) will be taught by Dr. G. Lee.

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Text *Abstract Algebra* (Third Edition) by D. Dummit and R. Foote

Course Content. Math 2231 and Math 2233, the two algebra courses at Lakehead, are an introduction to abstract algebra. Algebra, however, is such a large field that not everything can be covered in a one semester course. In this reading course, we concentrate on Ring Theory, thus taking the next step after Math 2231 - Ring Theory.

The main text for this course will be *Abstract Algebra* by Dummit and Foote. This is a first year graduate textbook on algebra. We will cover the following sections in the following order:

Basic Algebraic Objects and Constructions.

- 7.1 – Basic Definitions and Examples
- 7.2 – Examples: Polynomial Rings, Matrix Rings, and Group Rings
- 7.3 – Ring Homomorphisms and Quotient Rings
- 7.4 – Properties of Ideals
- 7.5 – Rings of Fractions
- 7.6 – The Chinese Remainder Theorem
- 8.1 – Euclidean Domains
- 8.2 – Principal Ideal Domains
- 8.3 – Unique Factorization Domains
- 9.1 – Definitions and Basic Properties (Polynomials)
- 9.2 – Polynomial Rings over Fields I
- 9.3 – Polynomial Rings that are Unique Factorization Domains
- 9.4 – Irreducibility Criteria
- 9.5 – Polynomial Rings over Fields II
- 10.1 – Basic Definitions and Examples (Modules)
- 10.2 – Quotient Modules and Module Homomorphism
- 10.3 – Generation of Modules, Direct Sums, and Free Modules
- 11.1 – Definitions and Basic Theory
- 11.2 – The Matrix of a Linear Transformation
- 11.3 – Dual Vector Spaces

Course Requirements. Our goal is to cover the above sections of the text. We will try to cover about one-two sections a week.

Since this is a reading course, you will be responsible for reading and learning the material primarily on your own. We will meet once a week (time and place to be determined) for an hour to discuss the new section and to discuss any problems you may have had on the material in the previous week. I will give a short overview, and may ask you to present some of your results.

I will assign a number of questions from each section (see attached list). You will be required to hand in your written solutions on the due date given. You must neatly write up your solutions in a correct mathematical way (for example, as you learned in ring and group theory). Not only will

you be graded on your solutions, you will be graded on your proof write up. I will use the following grading scheme:

- 5 pts A correct solution and a well written proof.
- 4 pts Most of the required ingredients are present, but there are a few technical problems with the solution.
- 3 pts Some of the needed ideas are present. However, the solution either lacks the final conclusion or has some problems in the exposition.
- 2 pts The proof has at most one or two of the needed ideas and/or the proof is poorly written.
- 1 pt An attempt at the solution has been made, but there is a major flaw in the logic of the proof, or the proof is not well written.
- 0 pts Little or no progress is made toward the solution.

An exercise that receives a mark of 3 or less can be rewritten and submitted for a new grade. A remarked exercise will receive a maximum of 4 points. For example, if on your first submission of an exercise you receive 2 points out of 5, you can rewrite the exercise (using the suggestions I gave you) to attain a higher mark. However, the maximum you can now receive on this exercise is 4 out of 5. A rewrite can be done at anytime (until the last day of class) and at most one time for any specific problem. When handing in an remarked assignment, you must include the original assignment so I can compare the two, and more importantly, up-date your mark!

Grading. I will use the following grading scheme

- 75%** – Homework Assignments
- 25%** – Final (Take Home Exam)

Schedule and Homework Questions.

The following is a rough guide of the schedule we will follow. You should make every attempt to stick to this schedule. If possible, try to work ahead since the material gets more dense as the course progresses.

Week	Section	Exercises	Due Date
1	7.1	7.1 – 5, 7, 12, 14, 17	Sept. 17
	7.2	7.2 – 3bc, 6, 10, 12	
2	7.3	7.3 – 6, 19, 24, 35	Sept. 24
	7.4	7.4 – 5, 10, 13, 31	
3	7.5	7.5 – 2	Oct. 1
	7.6	7.6 – 3, 4, 5	
	8.1	8.1 – 4, 6, 11	
4	8.2	8.2 – 3, 4, 6	Oct. 8
	8.3	8.3 – 1, 2 Challenge 5	
5	9.1	9.1 – 1, 4, 5, 6, 15, 16, 17	Oct. 15
6	9.2	9.2 – 1, 5, 8, 11	Oct 22
	9.3	9.3 – 1, 2	
7	9.4	9.4 – 2, 4, 7, 16	Oct 29
	9.5	9.5 – 1, 3, 5	
8	10.1	10.1 – 5, 7, 8, 9, 10, 13	Nov. 5
9	10.2	10.2 – 3, 8, 9, 11	Nov. 12
	10.3	10.3 – 4, 7, 8, 12, 13	
10	11.1	11.1 – 2, 4, 7, 8, 10	Nov. 19
11	11.2	11.2 – 1, 7, 11, 31, 36	Nov. 26
12	11.3	11.3 – 2, 3	Nov. 29