

# Reading Course: Introduction to commutative algebra.

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Meeting Hours: 10:30 am-12:30 pm Wed (Fine 510)  
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Homework assignments will be available on-line.

## 1 General information

Nowadays commutative algebra is one of the essential parts of studying mathematics. A solid background in commutative algebra can help a student in his or her study, not only in this subject itself, but also in various other topics such as homological algebra, algebraic geometry, algebraic number theory, non-commutative algebra and algebraic combinatorics.

## 2 Books

In this course, we will go through the excellent book by M. F. Atiyah and I. G. Macdonald, *Introduction to commutative algebra*. For some topics, we may also use some other resources, e.g. Matsumura's *Commutative algebra*, Sharp's *Steps in commutative algebra* and Ash's *A course in commutative algebra*.

## 3 Grading

The grading breakdown for this reading course is divided as follows:

- 50% Oral presentations.
- 20% Weekly assignments.
- 30% Final exam.

## 4 Homework

Each week, I will assign a set of homework exercises, which will be due the next meeting. Most of them will be assigned from the textbook.

## 5 Schedule

1. **10 Feb:** Prime ideals, Maximal ideals, Nilradical radical, Jacobson radical, Extension and contraction.  
*Read: Chapter 1*
2. **17 Feb:** Modules, Finitely generated modules, Nakayama's lemma, Exact sequences, Tensor product, Flat modules.  
*Read: Chapter 2*
3. **24 Feb:** Ring of fractions, Module of fractions and their relations with tensor product, exact sequences, etc. Localization. What a primary decomposition is.  
*Read: Chapter 3 and to the end of page 51*
4. **3 Mar:** Primary decompositions uniqueness theorems.  
*Read: Chapter 4*
5. **10 Mar :** Integral extensions, Going up and Going down theorems.  
*Read: Chapter 5, to the end of page 64*
6. **24 Mar:** Valuation rings, Noetherian and Artin rings.  
*Read: Chapter 5 (continue), Chapter 6*
7. **31 Mar:** Hilbert's basis theorem, Existence of the primary decomposition for Noetherian rings. *Read: Chapter 7*
8. **7 Apr:** More on Artin rings, DVR, Fractional ideals.  
*Read: Chapter 8, Chapter 9*
9. **14 Apr:** Dimension theory, Hilbert polynomial.  
*Read: Chapter 11, to the end of page 119*
10. **21 Apr:** Dimension theory of Noetherian rings, Krull's principal ideal theorem, Regular local rings, Transcendental dimension.  
*Read: The rest of Chapter 11*
11. **28 Apr:** Homological methods: Ext, Tor.  
*Read: Chapter 7 from Ash's book*