MATH 423/502: TOPICS IN ALGEBRA II
INTRODUCTION TO COMMUTATIVE ALGEBRA AND HOMOLOGICAL ALGEBRA

`Instructor:` Pramath Sastry
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`Office hours:` Mondays 11 am to 1 pm

Online vs. In-person teaching: This course will be online for a portion of the term. We will start in-person meetings on a date yet to be determined by the University. At the very earliest, this will be Jan 24th. This date may be updated as time goes on. When we resume in-person activities, we will meet in our scheduled classroom space on campus. For meetings prior to that time, we will meet on zoom, the link for which is:
https://ubc.zoom.us/j/67397942356?pwd=RW5zM1BpT1YwN2ZrMEVmMGRtQ2tQdz09
Meeting ID: 673 9794 2356
Passcode: 841203

Text: There is no required text, but the following books will be useful.

- Atiyah and MacDonald, "Introduction to Commutative Algebra"
- H. Matsumura, "Commutative Ring Theory"
- E. Kunz, "Introduction to Commutative Algebra and Algebraic Geometry"
- S. Bosch, "Algebraic Geometry and Commutative Algebra" (available online)
- C.A. Weibel, "An Introduction to Homological Algebra"

Links to some online notes will also be provided.

Course Outline: Approximately two thirds of this intense course will be focussed on Commutative Algebra and one third of the class will be Homological Algebra. The goal of the Commutative Algebra part is to serve as an introduction to Algebraic Geometry. It will cover the following topics

- A (quick) reminder of rings and ideals; prime ideals and maximal ideals.
- Nilradical, Jacobson radical
- Modules: tensor products.
- Local rings and localisation.
- Noetherian and Artinian rings
- Hilbert Basis Theorem
- Hilbert's Nullstellensatz
- Krull dimension
- Time permitting we will do one or more of the following topics: Integral extensions, Going Up and Going Down theorems, Smoothness, Singularities, Completions, Regular Local Rings, Flatness.

The Homological Algebra part of the course will cover the following topics

- Complexes, exactness, homology
- Exact, left exact, right exact functors
- Derived functors
- Ext, Tor, and other derived functors
- If time permits, we will give a homological characterisation of regular local rings.

Background expectations: The official pre-requisites are Math 412 or Math 501. The pre-requisite not listed in the math calendar is Math 323 (or at least some familiarity with rings and modules). You will need a good understanding of linear algebra.

Marking: Your homework will account for 60% of your marks and a take-home final essay (which you are also expected to present to the class as a lecture) will account for 40%. Interaction and collaboration on homework is encouraged, but if you collaborate, please acknowledge this in writing. Homework will be typically every other week and you will have a week to work on it.

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