Math 8211   Commutative and Homological Algebra   Fall 2021

10:10–11:00 MWF Vincent Hall 207
Instructor: Peter Webb
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Office Hours: MWF 11:15 - 12:05 or by appointment. I will be in my office at these times, and you can also contact me at the same moment using a gather.town link that is shown on my home page.

The manner of teaching
We will meet in person, and at the same time I will start a Zoom meeting with the link **https://umn.zoom.us/j/93474248338**, Meeting ID: 934 7424 8338 There is no password. I will record the session. I will teach by writing on my iPad in class, visible to the people on Zoom and in person. I will post the videos and my iPad notes on the Canvas site for the course. I plan to do a number of in-class activities involving collaborative work, and the collaborative aspect may be impossible for anyone who is online, so it is definitely an advantage to be present in person.

Text
David Eisenbud, Commutative Algebra with a View Toward Algebra Geometry, Springer. This book can be found online as a pdf. If you have trouble finding such a copy, let me know and I will help you.
This semester the goal is to go through the first half of this book, probably Sections 1-7 together with Appendices 3 and 5 on homological algebra and category theory.

Intended Syllabus
Review from chapter 0: prime ideals, unique factorization, modules etc 0.1, 0.2, 0.3
Significance of the Nullstellensatz   1.6
Fractions   2.1
Noetherian and Artinian rings   2.4
Hilbert's basis theorem   1.4
Hom and Tensor   2.2
Associated primes, Prime avoidance   3.1, 3.2
Primary Decomposition   3.3
More primary decomposition   3.6, 3.8
Nakayama's Lemma and the Cayley--Hamilton Theorem, Normalization   4.1, 4.2
Primes in an integral extension   4.4
The Nullstellensatz   4.5
Graded rings, Hilbert functions   1.5, 1.9
Associated graded rings   5.1
The blowup algebra, The Krull Intersection Theorem, Free resolutions   5.2, 5.3, 1.10
Tor, Flatness   6.1, 6.2, 6.3
Direct and inverse limits   A6
Completions, Cohen Structure Theorem   7.1, 7.2, 7.4
Maps from power series rings   7.6
Resolutions   A3.2, A3.3, A3.4
Homotopies and long exact sequences   A3.5, A3.6, A3.7, A3.8

Derived functors	A3.9, A3.10, A3.11
Dimension theory	8.1, 9.0

Course Assessment

There will be about 6 homework assignments during the course of the semester. If you make a genuine attempt at 50% or more of the questions you will get an A for the course. You do not have to obtain correct solutions to these questions, only make genuine attempts (in my opinion). I believe that it is extremely difficult to obtain a sound and permanently lasting command of the material presented without doing some work which actively involves the student. It should be possible for everyone who wishes to obtain an A on this course. Homework should be uploaded to Gradescope.

Expectations of written work

Most of the time in the homework problems, to satisfy my criterion of making a genuine attempt you will need to write down explanations for the calculations and arguments you make. Where explanations need to be given, these should be written out in sentences i.e. with verbs, capital letters at the beginning, periods at the end, etc. and not in an abbreviated form.
I encourage you to form study groups. However everything to be handed in must be written up in your own words. If two students hand in identical assignments, they will both receive no credit.

Prerequisites

Math 8201/2 or possibly Math 5285/6.

COVID-19

The University of Minnesota currently requires all students, staff, and faculty to wear masks when indoors regardless of vaccination status, and strongly encourages members of the campus community to get vaccinated. Resources are available for accessing vaccines.

Please stay at home if you experience symptoms of COVID-19 and consult with your healthcare provider about an appropriate course of action. An absence due to symptoms of COVID-19 is an excused absence, and I will work with you to find the best course of action for missed work and/ or class experiences.

Incompletes

These will only be given in exceptional circumstances. A student must have satisfactorily completed all but a small portion of the work in the course, have a compelling reason for the incomplete, and must make prior arrangements with me for how the incomplete will be removed, well before the end of the quarter.

Date of this version of the schedule: 9/7/2021