MATH 420/820 - Introduction to Commutative Algebra

Winter 2024

General information

Instructor:	Martin Frankland
Email:	Martin.Frankland@uregina.ca
Office:	CW 307.17
Office hours:	Tuesday 4-5 PM, Wednesday 5-6 PM, or by appointment.
	Office hours are held both in person and on Zoom (link posted on UR Courses).
Lectures:	MWF 9:30 - 10:20 AM in Classroom Building 431.
Textbook:	M.F. Atiyah and I.G. Macdonald, *Introduction to commutative algebra.*
Prerequisite:	MATH 222 and MATH 323 or similar course in abstract algebra.
UR Courses:	https://urcourses.uregina.ca/
	This site will contain announcements, additional course material, and solutions to selected problems. The site is updated throughout the semester, so please check back regularly.

Secondary references:

- Miles Reid, *Undergraduate Commutative Algebra.*

- David S. Dummit and Richard M. Foote, *Abstract algebra*, Third edition. Chapters 7, 8, and 9 for review; chapters 10, 15, and 16 for the main material.

Course outline

The course is a first semester in commutative algebra, which is the study of commutative rings and modules over them. Commutative algebra is closely related to algebraic geometry, going back to Hilbert's Nullstellensatz relating the zero set of some polynomials to the ideal of polynomials that vanish on the set. The prime spectrum of a commutative ring is the

building block of modern algebraic geometry, since the work of Grothendieck. Moreover, commutative algebra provides important tools in algebraic number theory.

The course covers roughly chapters 1–3 and 6–8 of Atiyah–Macdonald. Here is the list of topics:

- Prime and maximal ideals.

- Modules.

- Radicals and Nakayama's lemma.

- Exact sequences and the tensor product.

- Localization of rings and modules.

- Local rings and local properties.

- Noetherian rings.

- Artinian rings.

Grading scheme

- Homework: 40%

- Final Exam: 30%

- Project: 30%

Course delivery and computer requirements

The course is taught **in person**. Lectures, presentations, and the Final Exam all take place on campus.

Office hours will be offered both in person and on Zoom.

Exam

- Final Exam: **Wednesday April 17**, 9 AM - 12 PM.

The final exam covers the entire semester.

The exam will be **open book**: the textbook, notes, and class material are allowed. More details will be provided as to which resources are allowed and which are not.

Homework

Homework will be assigned more or less weekly and collected in class. Selected problems from each assignment will be graded.

Late homework will not be accepted.

The **lowest homework score** will be dropped.

For students registered in MATH 820: Each homework assignment will contain one designated graduate problem, which is part of the assignment for MATH 820 but not for MATH 420.

Project

You will work on a project on a topic of your choice related to the course. The project consists of two components:

- An expository written report, worth 20%.

- An oral presentation, worth 10%.

Missed course work

Information about missed course work can be found in the *Academic Regulations*, section "Deferral of Final Exams or Course Work", available at:

`https://www.uregina.ca/student/registrar/resources-for-students/academic-calendars-and-schedule/undergraduate-calendar/sections.html`

See in particular the sections "Grounds for Deferral" and "Supporting Documentation".

Schedule conflicts: If you have a schedule conflict between an exam and another course or university sponsored activity (e.g. conference, sports tournament), please contact me in advance, **no later than a week before the exam** in question.

Illness: If you are unable to meet a course requirement due to illness or other serious circumstances, please contact me as soon as possible.

Homework: If you miss a homework assignment for any reason, it will count as the lowest assignment being dropped. There will be no make-up homework.

Final: You will need to submit the form *Deferral of term work and/or final exam.* The version for undergraduate students is available at:

`https://www.uregina.ca/student/registrar/assets/docs/pdf/forms/deferral_form.pdf`

and the version for graduate students is available at:

`https://www.uregina.ca/gradstudies/assets/forms/graduate_deferral_form.pdf`

For more information, please consult the *Academic Regulations*, section "Deferral of Final Exam", or contact the Science Academic Hub:

`https://www.uregina.ca/science/student/`

Academic integrity

Working on homework with your peers is allowed. However, each student must write **their own** solutions. Handing in suspiciously similar solutions will be considered an instance of cheating.

Handing in any material copied from the internet or another source will likewise be considered cheating. **Cite sources** that you consult, for instance Wikipedia, Math Stack Exchange, or online course notes.

Scholastic offences are taken seriously and will not be tolerated. For more information, please consult the *Student Code of Conduct and Right to Appeal*, section "Academic Misconduct", available at:

`https://www.uregina.ca/student/registrar/resources-for-students/academic-calendars-and-schedule/undergraduate-calendar/sections.html`

Accessibility

Any student with special needs who may need accommodation should contact the Centre for Student Accessibility at:

`https://www.uregina.ca/student/accessibility/`

After I receive the letter from the Centre for Student Accessibility, please contact me to discuss the accommodation.