MATH 422/822 - Abstract Linear Algebra

Fall 2023

General information

Instructor:	Martin Frankland
Email:	Martin.Frankland@uregina.ca
Office:	CW 307.17
Office hours:	Tuesday 4-5 PM, Wednesday 4-5 PM, or by appointment. Office hours are held both in person and on Zoom (link posted on UR Courses).
Lectures:	TR 1:00 - 2:15 PM in Classroom Building 313.
Textbook:	Douglas Farenick, *Linear Algebra*. Posted on UR Courses.
Prerequisites:	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.

Course outline

Building on MATH 222, the course explores more in-depth the structure of linear transformations $T\colon V \to W$ between vector spaces.

There is substantial overlap in content between MATH 322 and 422, except that MATH 322 is done in coordinates whereas 422 is done in a coordinate-free way. That is, we manipulate vector spaces and linear transformations without choosing bases. MATH 322 emphasizes certain algorithms for matrices, whereas 422 emphasizes the algebraic structure in the background.

The course covers roughly Chapters 1–4 of the textbook, plus a bit of Chapter 5. Here is the list of topics:

- Vector spaces.
- Linear transformations.

- Dual spaces.
- Invariant subspaces.
- Jordan canonical form.
- Inner product spaces.
- Spectral theorem for normal operators.
- Polar decomposition.
- Tensor product of spaces.

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: **Thursday December 14**, 2–5 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 822: Each homework assignment will contain one designated graduate problem, which is part of the assignment for MATH 822 but not for MATH 422.

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 is considered an instance of cheating.

Handing in any material copied from the internet or another source is likewise 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`

as well as the *Faculty of Science Student Handbook*, section "Academic Integrity", available at:

`https://www.uregina.ca/science/assets/docs/pdf/programpdf/new-student-manual.pdf`

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.