

Math 223: Linear Algebra (Honours Version)

Schedule: Section 101, 10:00-11:00 MWF in MATX 1100

Instructor: Yaniv Plan

Office: Math Annex 1219

Email: yaniv@math.ubc.ca

Office Hours: See website.

Website: <http://www.yanivplan.com/math-223>

Textbook: *Linear Algebra and Its Applications*, by David C. Lay. Recommended but not required. Accessible and eloquent explanations, but problems in general too elementary. The assignments will be independent of the text.

Extra resources:

- The text, *Linear Algebra*, by Friedberg, Insel, and Spence, is often used for Math 223. It has a more theoretical focus and may make good supplementary reading.
- Richard Anstee has written a series of notes that gives an intuitive approach to the subjects in this class. We follow these notes. They will be posted on the webpage.
- **Math Learning Centre.** (MLC for short) A space for undergraduate students to study math together, with friendly support from tutors.

Outline: This course is aimed at excellent students who can go through the material at a faster pace than in MATH 152 or MATH 221. Focus will be put on creative thinking and abstract thinking. The following is a list of topics that will certainly be covered although not exactly in the order given.

- Linear and Matrix Algebra in 2×2 case, various chapters. Notes provided online.
- Gaussian Elimination and some of its uses. Ch.1 (1.1, 1.2, 1.3, 1.4, 1.5, 2.2)
- Determinants Ch.3 (3.1, 3.2, 3.3)
- Vector Spaces in R^n (also lines, planes). Ch.4 (1.7, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7)
- Eigenvalues and Eigenvectors. Ch.5 (5.1, 5.2, 5.3, 5.5)
- Linear Transformations and matrices. (1.9, 3.3, 5.4)
- Orthogonality and Least Squares. Ch.6 (6.1, 6.2, 6.3, 6.4, 6.5) (Orthogonal)
- Diagonalization of Symmetric Matrices. Ch.7 (7.1, 7.2)

Grading: 50% final, 30% midterm, 20% assignments.

Assignments: There will be about 10 assignments. Students may work together on assignments but must write up their work independently. Copying is forbidden. Any 2 (or more) assignments with some virtually identical answers deemed the result of copying will be given 0 total credit. The students are reminded of the plagiarism policies of the University.

Midterm: One 50 minute midterm scheduled for Wednesday, Oct 23 (in class). If the midterm is missed for a valid reason (e.g., medical), the final exam will be reweighted to count for 80% of the final grade.

Final: 2.5 hours during final examination period.

Missed work: Missing homework will result in a score of zero for that assignment, but the lowest homework score will be dropped from the final grade. Nevertheless, I recommend completing all homework assignments to best learn the material. In the case of the Final Exam, the students should contact the Faculty of Science office and the missed final will be handled in a formal way.

Learning goals:

1. Solve challenging questions which require you to think outside the box (after all, this is an honours course)
2. Write simple proofs
3. Work with real numbers, complex numbers, abstract vector spaces, general inner product spaces, and abstract linear transformations
4. Add, multiply, invert matrices
5. Solve linear systems of equations via Gaussian elimination
6. Compute determinants of matrices
7. Compute eigen-value decomposition and use it to compute high powers of matrices
8. Solve linear recursion relations
9. Understand and compute change of basis of a matrix
10. Compute partial fractions
11. Compute dimension of a vector space or subspace
12. Determine whether or not a set (together with a definition of addition and scalar multiplication) is a vector space
13. Characterize null space and range of a matrix, be able to use corresponding orthogonality relationships
14. Solve systems of linear differential equations
15. Apply the Gram-Schmidt algorithm, find orthogonal projection matrices
16. Recognize and manipulate singular value decomposition
17. Solve least squares problems

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UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious and cultural observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions. Details of the policies and how to access support are available [here](#).