MATH 102, Applied Linear Algebra
3 Credits, 3 hours lecture, 1 hour lab

This course covers vector and matrix algebra, systems of linear equations, vector geometry in the plane and in space, determinants, orthogonality and applications, eigenvalues and eigenvectors with applications, complex vector spaces. The course will also introduce students to the use of the computer algebra system MATLAB in solving problems in Linear Algebra.

Prerequisites and/or co-requisites: MATH 100

Instructor

Instructor Name: Matthew Morin
Office location: S211E
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Office Hours

Monday	10:00 – 11:00
Tuesday	10:00 – 11:00
Wednesday	10:00 – 11:00
Thursday	10:00 – 11:00
Friday	10:00 – 11:00

Hours of Instruction

Tuesday	13:30 – 15:00 (S112)
Thursday	14:00 – 15:30 (S112)
Friday	14:00 – 15:00 (S112)

Required Resources

Elementary Linear Algebra, Applications Version, Howard Anton, Chris Rorres, 11th edition, ISBN 978-1-118-43441-3

Course Outcomes

Upon successful completion of this course, the student shall be able to:

- Perform basic algebraic operations with matrices and vectors (addition, scalar multiplication, products).
- Use vectors and matrices to represent equations, geometrical relationships, transformations, and other concepts.
- Row reduce a matrix to its row reduced echelon form and use this form to solve linear equations, test independence, determine fundamental matrix spaces, and solve other matrix problems.
- Compute the determinant of a matrix and use it to determine properties of the matrix.
- Determine a basis for a given space/subspace and create a set of coordinates with respect to this basis.

- Determine the fundamental spaces associated with a matrix (row space, column space, null space, eigenspace) and describe the relationships between the geometry of these spaces.
- Determine whether or not a given matrix is diagonalizable, and—if it is—determine a diagonalization.
- Use the Gram-Schmidt process to determine an orthogonal (or orthonormal) basis of an inner product space and use this basis to perform projections.

Evaluation

Assignments	12%
Lab Assignments	3%
Midterm Exam	40% (two exams, 20% each)
Final Exam	45%
Total	100%

A grade of C- is required for progression or transfer.

Note: Prior to the final exam, any question about a student's standing in a course will be assessed based on a projection that includes all of the course components listed above with the appropriate weighting. An assignment projection will be extrapolated from the assignment scores to-date. Similarly with lab assignment scores. A projected final exam score will be based on the student's midterm exam score(s).

Assignments:

In any mathematics course the best way "to learn" is "to do." The instructor can teach you about the course ideas and demonstrate the mechanics of solving the problems—and can make it look very easy—but growing adept at solving these problems will take a lot of practice and can be a struggle. Although the assignments do not count for a large part of your final grade they are essential in preparing you for the types of problems you will be solving on the exams.

Assignment completion is a requirement of the course. Failure to complete all the assignments may result in a failing grade for the course.

The course assignments are sets of problems you will solve at home then hand in your solutions in-class. A cover page is not required, but the assignment number, the course number, and your name should be clearly written on the front page. Homework problems should be presented in the order that they were listed. If more than one page is needed, then the pages should be stapled together (in the proper order). A late assignment may be accepted, or may incur a penalty depending on the circumstances. Once marked assignments are returned to the class, no further late assignments can be submitted.

In addition to the submitted paper copy, ***a digital version of each homework set must also be uploaded to our course's Moodle page***. If your solutions are handwritten, you may scan your work at one of the college photocopiers (such as the Library, the Skill Center, or the Info Commons), have the copier email the scan(s) to your Keyano email account, and then upload to our Moodle page.

Although you are permitted to work with other students while completing assignments, it is essential that the work you present is your own—see the section on Academic Misconduct later in this outline for more information. Presenting other students' solutions as your own may result in serious academic penalties. If you are working together with other students on a problem, it is vital that at the end of the process YOU know how to solve the problem and that YOU write out your own solution in your own way. If there is suspicion of academic misconduct, you will be required to defend the work you have submitted.

It is recommended that you attempt the assignments yourself before talking over problems with your classmates. If you need help with a problem you can come to office hours, visit the Skill Center, and (yes) talk to your classmates. However, this does not mean looking through a classmate's solution. Rather, it is best if you talk about the problem. If you do not understand what the problem is asking for, then it could be useful to read through the relevant sections of the textbook and the course notes.

Tests:

All tests will be written and are closed-book. No calculators are allowed, nor should they be needed. The dates of most tests will be announced in-class and on Moodle well in advance of the test date. The details of the topics covered by tests will be given and a sample test will usually be provided. These tests are meant to test how well you have "mastered" the subject matter. Satisfactory completion of the relevant assignment problems, reading the relevant textbook sections, and studying the course notes is the very minimum amount of work that should prepare you for the types of problems that could appear on a test. However, as the larger tests are cumulative in nature, you may be solving problems that require ideas that bridge across several sections of the course.

Grading System

Descriptor	Alpha Grade	4.0 Scale	Percent	Rubric for Letter Grades
Excellent	A+	4.0	> 92.9	Work shows in-depth and critical analysis, well developed ideas, creativity, excellent writing, clarity and proper format.
	A	4.0	85 – 92.9	
	A-	3.7	80 – 84.9	
Good	B+	3.3	77 – 79.9	Work is generally of high quality, well developed, well written, has clarity, and uses proper format.
	B	3.0	74 – 76.9	
	B-	2.7	70 – 73.9	
Satisfactory **Progression**	C+	2.3	67 – 69.9	Work has some developed ideas but needs more attention to clarity, style and formatting.
	C	2.0	64 – 66.9	
	C-	1.7	60 – 63.9	
Poor **Minimum Pass**	D+	1.3	55 – 59.9	Work is completed in a general way with minimal support, or is poorly written or did not use proper format.
	D	1.0	50 – 54.9	
Failure	F	0.0	< 50	Responses fail to demonstrate appropriate understanding or are fundamentally incomplete.

Proposed Schedule of Topics

Week	Dates	Topic	Chapter Sections
1	Jan. 7 - Jan. 11	Introduction, Matrix Operations, Systems of Equations	1.1, 1.2, 1.3
2	Jan. 14 - Jan. 18	Gaussian Elimination, Inverses	1.4, 1.5
3	Jan. 21 - Jan. 25	Properties of Systems and Matrices, Determinants	1.6, 2.1, 2.2
4	Jan. 28 - Feb. 1	Determinant Properties and Cramer's Rule, Euclidean Space	2.3, 3.1, 3.2
5	Feb. 4 - Feb. 8	Dot Product, Cross Product, **Midterm 1 Feb. 7th**	3.3, 3.5
6	Feb. 11 - Feb. 15	Geometry of Linear Systems, Vector Spaces	3.4, 4.1

Week	Dates	Topic	Chapter Sections
	Feb. 18 - Feb. 22 **(No Classes this week!)**	**Family Day + Reading Days**	
7	Feb. 25 - Mar. 1	Subspaces, Independence	4.2, 4.3
8	Mar. 4 – Mar. 8	Coordinates, Dimension, Change of Basis	4.4, 4.5, 4.6
9	Mar. 11 – Mar. 15	The Fundamental Spaces of a Matrix, Rank Equation, Matrix Transformations	4.7, 4.8, 4.9
10	Mar. 18 – Mar. 22	Matrix Transformations (cont.) **Midterm 2 March 21st**	4.10
11	Mar. 25 – Mar. 29	Eigenvectors / Eigenvalues, Diagonalization	5.1, 5.2
12	Apr. 1 – Apr. 5	Inner Products, Orthogonality, Gram-Schmidt Process	3.3(cont.), 6.1, 6.2, 6.3
13	Apr. 8 – Apr. 12 **April 10th: Last day of Classes**	Orthogonal Matrices, Orthogonal Diagonalization	7.1, 7.2
	Apr. 15 – Apr. 25	**Exam Period**	

Please Note:

Date and time allotted to each topic is subject to change.

Performance Requirements

Student Responsibilities

It is your responsibility as a student to contact the Office of the Registrar to complete the forms for Withdrawal or Change of Registration, and any other forms. Please refer to the list of important dates as noted in the Academic Schedule in the Keyano College credit calendar.

More specific details are found in the Student Rights and Student Code of Conduct section of the Keyano College credit calendar. It is the responsibility of each student to be aware of the guidelines outlined in the Student Rights and Student Code of Conduct Policies.

Laboratory Safety

In the science laboratories, safety is important and therefore students must complete the *WHMIS for Students* online training course on Moodle before entering the science laboratories.

Students must comply with the mandatory laboratory safety rules for this course as provided in the laboratory manual. Failure to do so will result in progressive discipline such as a verbal warning, refused entry into the laboratory, or suspension from the College.

Before entering the lab, students are responsible reviewing the lab manual and relevant Safety Data Sheets for the purpose of evaluating risks associated to health. Some hazards used in the laboratory may have additional risks to those with pre-existing medical conditions.

Student Attendance

Class attendance is useful for two reasons. First, class attendance maximizes a students' learning experience. Second, attending class is a good way to keep informed of matters relating to the

administration of the course (e.g., the timing of assignments and exams). Ultimately, you are responsible for your own learning and performance in this course.

It is the responsibility of each student to be prepared for all classes. Students who miss classes are responsible for the material covered in those classes and for ensuring that they are prepared for the next class, including the completion of any assignments and / or notes that may be due.

Academic Misconduct

Students are considered to be responsible adults and should adhere to principles of intellectual integrity. Intellectual dishonesty may take many forms, such as:

- Plagiarism or the submission of another person's work as one's own
- The use of unauthorized aids in assignments or examinations (cheating)
- Collusion or the unauthorized collaboration with others in preparing work
- The deliberate misrepresentation of qualifications
- The willful distortion of results or data
- Substitution in an examination by another person
- Handing in the same unchanged work as submitted for another assignment
- Breach of confidentiality.

The consequences for academic misconduct range from a verbal reprimand to expulsion from the College. More specific descriptions and details are found in the Student Rights and Student Code of Conduct section of the Keyano College credit calendar. It is the responsibility of each student to be aware of the guidelines outlined in the Student Rights and Student Code of Conduct Policies.

In order to ensure your understanding of the concept of plagiarism, you must successfully complete the online tutorial found on ilearn.keyano.ca. Then print the certificate, sign it, and show it to each of your instructors. Your course work will not be graded until you show this signed certificate.

Specialized Supports

The Student Academic Support Services (SASS) department: Accessibility Services, Skill Centre and Wellness Services, work together to support student success at Keyano College.

Accessibility Services (CC167) supports student success through group and individualized instruction of learning, study and test taking strategies, and adaptive technologies. Students with documented disabilities, or who suspect a disability, can meet with the Learning Strategists to discuss accommodation of the learning barriers that they may be experiencing. Students who have accessed accommodations in the past are encouraged to visit our office at their earliest opportunity to discuss the availability of accommodations in their current courses. Individual appointments can be made by calling 780-791-8934

Skill Centre (CC119) provides a learning space where students can gather to share ideas, collaborate on projects and get new perspectives on learning from our tutorial staff. Students visiting the centre have access to one-to-one or group tutoring, facilitated study groups, and assistance in academic writing. The Skill Centre's Peer Tutor program provides paid employment opportunities for students who have demonstrated academic success and want to share what they have learned. Tutoring is available free to any students registered at Keyano College on a drop in basis, from 9:00 am to 5:00 pm Monday through Friday. Additional evening hours are subject to tutor availability and are posted in the Skill Centre.

Wellness Services (CC260) offers a caring, inclusive, and respectful environment where students can access free group and individual support to meet academic and life challenges. Mental Health Coordinators offer a safe and confidential environment to seek help with personal concerns. The

Mindfulness Room in CC260 is available as a quiet space for students to relax during regular office hours. Wellness Service welcomes students to participate in any of the group sessions offered throughout the academic year addressing such topics as Mindfulness and Test Anxiety. Individual appointments can be made by calling 780-791-8934.

Please watch your Keyano email for workshop announcements from our Student Academic Support Services team.