MA432: Linear Algebra

Spring 2022

Instructor:	Prashant Shekhar, PhD	**Email:**	shekharp@erau.edu
Class Time:	M,W,F: 9:00AM – 9:50AM	**Class Venue:**	Bldg COAS Rm. 405
Office Hours (OH):	M,W,F: 2:00PM – 3:00PM	**OH Venue:**	Room 301.26, COAS.

Topics Included: Vector and matrix operations including matrix inverses, eigenvectors, and eigenvalues. Equations of lines and planes, vector spaces including basis and dimensions, linear transformations, change of basis, diagonalization of matrices, inner products and orthonormal bases, applications.

Why this course: The concepts that you learn in this course can be utilized to solve problems in applied mathematics and data sciences/machine learning. Some of the applications include: signal processing, computer vision, control theory, deep learning, computer animation and pattern recognition etc.

Text Book: Linear Algebra and Its Applications by David C. Lay, Steven R. Lay, and Judi J. McDonald, Fifth Edition, published by Pearson

Attendance: I will take attendance in every class. I encourage you to participate in class activities because attendance is usually found to be heavily correlated with the course grade. Additionally, a portion of the course grade depends on class participation, making attendance very important. You are expected to be attentive to the Canvas site to take quizzes and tests, pay attention to announcements, and keep a track of your grades.

Calculators: You could use a scientific calculator to work on in-class problems. Graphing calculators are not allowed on quizzes and exams.

Grading: Your grade will be determined as:

1. Homework: 25%
2. Quizzes: 15%
3. Tests: 30%
4. Final Project: 20%
5. Attendance/Class participation: 10%

The grading scale will follow the standard scale
A: 90% - 100%
B: 80% - 89.5%
C: 70% - 79.5%
D: 60% - 69.5%
F: <60%

Homework: Your homework grade is determined based on four homeworks. Apart from the homeworks, I will post a list of additional questions from your textbook. You are expected to work on those questions to achieve proficiency in the material.

Quizzes and Tests: You will have 4 quizzes and 2 tests. Make-ups on any of these exams may be allowed only for valid extenuating circumstances when I am informed before the exam takes place – please see me about conflicts as soon as they occur.

Final Project: During the semester you will be supervised to work on a computer-based project which combines classroom materials and real-world applications. The project is the final classroom assignment. I will assign the project in the second half of the semester and you are expected to work individually on it. I will announce guidelines, and rubric in due course.

Academic Integrity: Embry-Riddle Aeronautical University maintains high standards of academic honesty and integrity in higher education. To preserve academic excellence and integrity, the University prohibits academic dishonesty in any form, including, but not limited to, cheating and plagiarism. More specific definitions of these violations and their consequences are described in the Dean of Students' Honor Codes and Student Policies.

Disability Services DSS Administration Office: Bldg 500; Contact: (386) 226-7916; email: dbdss@erau.edu
Testing Center: The Annex Building 2nd floor, room 217; Contact: (386) 226-2903; email: dbdss@erau.edu

- Student Disability Services: Students with disabilities who believe that they may need accommodations in this class are encouraged to contact the Office of Disability Services. Professors cannot make appropriate disability accommodations. Students are encouraged to register with DSS at the beginning of the term to better ensure that such accommodations are implemented in a timely fashion. Accommodations are not granted until official notice is received from DSS.
- DSS Testing Procedures: It is the responsibility of the student to notify DSS the date and time of test once s/he has been made aware of the scheduled test. DSS requires a 2 days minimum notification.

ERAU Coronavirus Updates: Information on testing, vaccinations, health services, procedures and frequently asked questions are available here.

- **Face Masks Strongly Encouraged**: Consistent with current recommendations of the Centers for Disease Control and Prevention, and Embry-Riddle's long-standing culture of safety, all students (vaccinated or unvaccinated) are strongly encouraged to wear face masks indoors especially during their in-person classes and in other group indoor settings, including faculty office hours.
- **Vaccinations Strongly Encouraged**: All students are strongly encouraged to receive a vaccination against Covid-19. Vaccinations are available at convenient campus locations.

MA432 Linear Algebra: Spring 22

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Tentative Schedule for Spring 2022

Week Number: Starting day (days)	*Section Number*	*Topic*	*Homeworks*	*Learning Outcome*
1: 12^{th} Jan (W,F)	1.1	System of Linear Equations		1
2: 17^{th} Jan (W,F)	1.2 1.3	Row Reductions Vector Equations		1 2,3
3: 24^{th} Jan (M,W,F)	1.4	Matrix Equations Review for Quiz 1 Quiz 1		1,3
4: 31^{st} Jan (M,W,F)	1.5 1.7 1.8	Solution of Linear Systems Linear Independence Introduction to Linear Transformation	HW1 released	1, 3, 12 5 6
5: 7^{th} Feb (M,W,F)	1.9	The Matrix of Linear Transformation Test1 Review Test1	HW1 due	6,7,12
6: 14^{th} Feb (M,W,F)	2.1 2.2 2.8	Matrix Operations Inverse of a Matrix Subspaces	HW2 released	2 1,12 2,4,5
7: 21^{st} Feb (W,F)	2.9	Dimension and Rank Quiz 2	HW2 due	4,5,8
8: 28^{th} Feb (M,W,F)	4.1 4.2 4.3	Vector Spaces and Subspaces Null Spaces and Column Spaces Linearly Independent Sets, Bases	HW3 released	2,4,5 2,4,5,7,8 4,5,8
9: 7^{th} Mar (M,W,F)	3.1 3.2	Introduction to determinants Properties of determinants Quiz3	HW3 due	1,9 1,9
Spring Break				
11: 21^{st} Mar (M,W,F)	5.1 5.2 5.3	Eigenvectors and Eigenvalues The Characteristic Equation Diagonalization	HW4 released	9 9 7,9,11,12
12: 28^{th} Mar (M,W,F)	6.1	Inner Product Test 2 Review Test 2	HW4 due	10
13: 4^{th} Apr (M,W,F)		Project day 1 Project day 2 Project day 3	Project released	12 12 12
14: 11^{th} Apr (M,W,F)	2.5 6.2 6.4	Matrix Factorization Orthogonal Sets Gram Schmidt Process		1, 12 10, 12 11, 12
15: 18^{th} Apr (M,W,F)		Review for Quiz4 Quiz 4 Project help		 12
16: 25^{th} Apr (M,W)		Project help	Project due	12

Learning outcome: After successful completion of this course, you will acquire knowledge to:

1. Use Gaussian Elimination to solve systems of linear equations or to calculate matrix inverses.
2. Perform vector and matrix operations such as addition and multiplication.
3. Calculate equations of planes and lines in three dimensions.
4. Use the definition of vector spaces to identify vector spaces and subspaces.
5. Test set of vectors for linear independence and calculate bases for given vector spaces.
6. Calculate matrices representing linear transforms such as projections, reflections, and rotations.
7. Use similarity transforms to calculate matrix representations of linear transforms when a new basis is selected.
8. Use matrices to solve linear homogeneous and non-homogeneous equations and relate the rank and nullity of the matrices to the linear equations.
9. Calculate a basis of eigenvectors so that a linear transformation is represented by a diagonal matrix.
10. Use the definition of inner product in a variety of vector spaces and use Gram-Schmidt process to construct an orthonormal basis for a vector space.
11. Identify orthogonal matrices and symmetric matrices and utilize their properties for matrix decompositions.
12. Apply the concepts learnt in the course to problems of practical importance.