

**MATH 21**  
LINEAR ALGEBRA  
*Summer 2023 - Session 2*

**Course Description:** Systems of linear equations, matrices, determinants. Introduces abstract vector spaces, linear transformation, inner products, the geometry of Euclidean space, and eigenvalues.

**Prerequisites:** Math 11A or Math 19A or Math 20A or AMS 11A or AMS 15A

**References:**

- Bruce Cooperstein. *Elementary Linear Algebra: An eTextbook*, Version 2.0, 2010. This will be the primary reference text. A free ebook version can be found by clicking this link: <https://www.math.ucsc.edu/math21.html>
- Gilbert Strang. *Linear Algebra and Its Applications*, 4th Edition, 2005.
- Sheldon Axler. *Linear Algebra Done Right*, 3rd Edition, 2015.

**Lecture Time and Zoom Link:** MoWeFr 9:00 AM - 11:30 AM, at <https://ucsc.zoom.us/j/99352071076?pwd=RTZjdi9pT2ZyWjZnZlZlYThNlV2R4dz09>

**Class Dates:** July 31, 2023 - September 1, 2023

**Instructor:** John Pelias

**Instructor's E-mail:** [jppelias@ucsc.edu](mailto:jppelias@ucsc.edu)

**Instructor's Office Hours and Location:** TuTh 11:30 AM - 12:30 PM, at <https://ucsc.zoom.us/j/91586476866?pwd=WUdYcHUrR0JWVWHY1OGVOYXcxZjRiZz09>

**TA:** Yousra Al-Idrisi

**TA's E-mail:** [yalidrisi@ucsc.edu](mailto:yalidrisi@ucsc.edu)

**TA's Office Hours and Location:** WeFr 1:00 PM - 2:00 PM, at <https://ucsc.zoom.us/j/94804809790?pwd=eXBIRWlxOEtTMWQvUmV0T1A3Qm5jZz09>

**Grading:**

20% Homeworks  
30% Long Quizzes  
20% Project  
30% Final Exam

**Homeworks:** There will be 4 weekly Homeworks, due every Monday. (Note that the first Homework is due on the Monday of the second week.) You are encouraged to discuss with your peers, but you are expected to turn in your individual work.

**Long Quizzes:** There will be two Long Quizzes, each to be taken on **August 14, 2023 (Tuesday)** and **August 28, 2023 (Tuesday)**.

**Project:** There will be a Project, to be done in groups of *at most 4 people*, in which you will have the opportunity to explore applications of linear algebra beyond the course. Your work shall culminate in a paper, due on **September 1, 2023 (Friday), 11:59 PM**.

**Final Exam:** There will be a cumulative Final Exam on **September 1, 2023 (Friday)**.

**Late/Makeup Policy:** I will neither accept late homeworks/projects nor give makeup exams.

**Tentative Schedule:** (subject to change, based on actual progress of the class)

Week	Content
1	<b>1: Linear Equations</b> linear equations and systems, matrices, row echelon form, Gaussian elimination
2	<b>2: The Vector Space <math>\mathbb{R}^n</math></b> vectors, the space $\mathbb{R}^n$ , span and linear independence in $\mathbb{R}^n$ , subspaces and bases in $\mathbb{R}^n$ , dot product, orthogonal projection and complements in $\mathbb{R}^n$
3	<b>3: Matrix Algebra</b> linear transformations, matrix operations, invertible matrices, elementary matrices
4	<b>4: Determinants</b> determinants, adjoints, Cramer's Rule <b>5: Abstract Vector Spaces</b> abstract vector spaces, span, linear independence, dimension, coordinate vectors, change of basis, rank and nullity of a matrix
5	<b>6: Linear Transformations</b> linear transformations, range and kernel, Rank-Nullity Theorem, matrix of a linear transformation <b>7: Eigenvalues and Eigenvectors</b> eigenvalues, eigenvectors, diagonalization