

MATH 244 - Linear Algebra

Course Coordinator: Fahd M Alshammari

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OFFICE	160 2A Building 4
OFFICE HOURS	Monday and Wednesday

Course description

An undergraduate introduction to linear algebra covering systems of linear equations, matrices, determinants, vector spaces, inner product spaces, linear transformations, eigenvalues, eigenvectors, and diagonalization. The course balances computation with interpretation, structural reasoning, and clear mathematical communication.

Course learning outcomes

- 1.1 Identify the association between matrices and linear equations and linear transformations and performs matrix operations and their main properties.
- 1.2 Distinguish vector spaces and subspaces and their basis elements and inner product spaces, linear transformations and their kernels and images and know their basic properties for them.
- 2.1 Solve a system of linear equations by using different methods.
- 2.2 Calculate the determinants and the inverse of an invertible matrix by using different methods
- 2.3 Decide whether a set of vectors is linearly dependent or independent or basis of a vector space; whether a set of vectors is orthogonal or orthonormal; whether a transformation between vector spaces is linear or not.
- 2.4 Apply the Gram- Schmidt process to find orthonormal basis of an inner product space.
- 2.5 Compute the eigenvalues of a square matrix and their associated eigenvectors, algebraic & geometric multiplicities and by using these determining the diagonalizability of a given matrix and evaluating powers of such matrices.
- 3.1 Work Effectively in a team

Learning resources

Required textbook: Howard Anton and Chris Rorres, Elementary Linear Algebra: Applications Version, 11th edition, Wiley, 2014.

Course materials: Instructor lecture slides, tutorial sheets, review notes, and LMS announcements.

Assessment and grading

Assessment	Timing	Points	Proposed coverage
Midterm examination 1	TBD	25	Topics will be announced at least one week before
Midterm examination 2	TBD	25	Topics will be announced at least one week before
Tutorial work	five quizzes	10	• Sections covered by time of quiz. See table below. • Score is the average of the 5-quizzes. • No make-up quizzes.
Final examination	Dec 23 2026	40	Comprehensive

Tutorial quizzes

Quiz	Suggested week	Coverage
Quiz 1	Week 3	Basic matrix operations and Determinants
Quiz 2	Week 5	Linear Systems
Quiz 3	Week 9	Vector spaces
Quiz 4	Week 11	Inner products, orthogonality, and Gram-Schmidt
Quiz 5	Week 14	Linear transformations and eigenvalue fundamentals

Weekly course timetable

Week	Unit	Text	Lecture emphasis (3 hours)	Tutorial (2 hours)
1	Matrices I	1.3-1.4	Matrix notation and operations; multiplication; transpose; inverse properties	1.3-1.4
2	Matrices II	1.5-1.7	Elementary matrices; inverse by row reduction; invertible-matrix conditions; special matrices	1.5-1.7; Quiz 1
3	Determinants	2.1-2.3	Cofactor expansion; row-reduction evaluation; determinant properties; adjoint; Cramer's rule	2.1-2.3
4	Systems of linear equations	1.1-1.2	Consistency, solution sets, REF/RREF, Gaussian and Gauss-Jordan elimination	1.1-1.2
5	Vector spaces I	4.1-4.2	Vector-space axioms, examples and counterexamples, subspaces, span	4.1-4.2; Quiz 2
6	Vector spaces II	4.3-4.4	Linear independence, dependence, bases, coordinates	4.3-4.4
7	Vector spaces III + Midterm 1	4.5	Dimension; basis extension and reduction; Midterm 1 held during Week 7	4.5-4.6 and Midterm 1 review
8	Vector spaces IV	4.6-4.8	Change of basis; row, column, and null spaces; rank-nullity; consistency	4.6-4.8
9	Inner products I	6.1-6.2	Inner products, norms, distances, angles, orthogonality, orthonormal sets	6.1-6.2; Quiz 3
10	Inner products II	6.3	Gram-Schmidt orthonormalization; coordinates relative to orthonormal bases	6.3
11	Linear transformations I	8.1	Linearity, matrix transformations, kernel, range, rank, and nullity	8.1; Quiz 4
12	Linear transformations II + Midterm 2	8.1-8.2	One-to-one and onto maps; compositions and inverses; Midterm 2 held during Week 12	Selected 8.1-8.2 and Midterm 2 review
13	Matrices of transformations	8.4	Standard and nonstandard matrix representations; coordinate conventions; composition	Selected 8.4
14	Eigenvalues and eigenvectors	5.1	Characteristic equation, eigenspaces, multiplicities, triangular matrices	5.1; Quiz 5
15	Diagonalization and consolidation	5.2	Diagonalizability criteria, diagonalization, powers of matrices, cumulative review	5.2 and final review

Suggested textbook exercises

Tutorial instructors may identify a smaller core subset for tutorials.

Section	Suggested exercises
Unit 1 - Systems of Linear Equations and Matrices	
1.1	1, 5, 6, 8, 10, 14(a,c), 16, TF Exercise
1.2	1, 2, 4, 5, 6, 9, 10, 13, 14, 16, 17, 18, 29
1.3	1, 2, 3, 4, 6, 11, 15
1.4	1(c,d), 2(a,b), 3, 4, 5, 6, 7, 8, 10, 11, 16, 17, 22(b), 45(a)
1.5	1,4,5(c), 7(a), 10(a), 11(a), 19(a,b), 22, 29
1.6	1, 3, 5, 7, 8, 10, 14, 15, 18, 19
1.7	1, 2, 3, 4, 7, 9, 11, 17(a), 25, 27, 32, 34, TF Exercise
1.8	11(a), 12(b), 13(b,c), 14(a,d), 16, 17, 19, 27, 31
Unit 2 - Determinants	
2.1	1, 3,5, 6, 9, 10, 15, 16, 19(b,c), 21, 27, 28, 30, 34, TF Exercise
2.2	1, 4, 6, 7, 10, 12, 15-22, 24
2.3	1, 4, 5, 7, 8, 15, 18, 20, 24, 25, 30, 35
Unit 3 - Vector Spaces	
4.1	1,2,3,4,5,6,7,8,9; TF (a, c, e)
4.2	1, 2, 3, 8, 9, 10, 11, 12, 13, 15
4.3	1, 2(b,d), 3(b,c), 4(a,c), 9, 11, 16(a,c)
4.4	1,2,3,4,5, 7(a), 8, 9, 11(a), 13(a), 14(a), 15
4.5	1, 2, 6, 8, 10, 12(a), 14, 15, 16
4.6	1, 3, 5-8
4.7	1(b), 2(b), 3(a), 5, 7(a,b), 9(b), 10(b), 11(b) , 12(b), 14, 16, 19
4.8	1(a,b), 3, 7, 9, 10, 15, 18, 19, 28
Unit 4 - Inner Product Spaces	
6.1	1,2,3,7,11,27,28, TF Exercises
6.2	1,5,7,13,21, TF Exercises
6.3	2,4,7,8, 9, 10, 27,28,29

Section	Suggested exercises
Unit 5 - General Linear Transformations	
8.1	1,2,3,6,7,9,12,19; TF (a, e, f, h)
8.2	1, 3, 5-7, 11, 19; TF (a, d)
8.4	1,3,4,6(a,b),7; TF (c, e)
Unit 6 - Eigenvalues and Diagonalization	
5.1	3, 5(a,d), 7, 9, 13, 14, 33
5.2	1,3,5,7,11, 13, 14, 17

Important Notes

- Attendance is taken regularly in the beginning of class. More than 25% absence causes denial from final exam entry. Being late more than 5 minutes twice counts as 1 absence.
- University Policies, Rules, and Regulations are applied. Find them
 - [here](https://dar.ksu.edu.sa/ar/regulations) (<https://dar.ksu.edu.sa/ar/regulations>) and
 - [here](https://vrea.ksu.edu.sa/ar/node/3037) (<https://vrea.ksu.edu.sa/ar/node/3037>).

Read them, understand them, and live by them.

- Please inform me and/or the department if you have Special needs or require any Accommodations.