

# King Fahd University of Petroleum & Minerals

## Department of Mathematics and Statistics

Syllabus of Math 325 (222)

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**Title:** Linear Algebra

**Textbook:** *Serge Lang, Linear Algebra, 3rd Edition (Springer), 1987.*

**Description:** Theory of vector spaces and linear transformations. Direct sums. Inner product spaces. The dual space. Bilinear forms. Polynomials and matrices. Triangulation of matrices and linear transformations. Hamilton-Cayley theorem.

**Prerequisite:** Math 225

Week	Date	Section	Material	Homework Problems
1	Jan 15 – Jan 19	1.1 1.2	<b>Vector spaces:</b> Definitions Basis	2, 4, 8b, 9b, 10, 12 1g, 5b, 5f, 10
2	Jan 22 – Jan 26	1.3 1.4	Dimension of a vector space Sums and Direct Sums	1, 2
3	Jan 29 – Feb 2	3.2 3.3	<b>Linear Mappings:</b> Linear Mappings The Kernel and Image of a Linear Map	1c, 1e, 1f, 1g, 3, 5, 15, 18b 2, 5, 12, 14, 17, 18
4	Feb 5 – Feb 9	3.4 4.1	Composition and Inverse of Linear mappings <b>Linear Maps and Matrices:</b> Linear Map Associated with a Matrix	2, 7, 10, 17, 19 1(a), 1(d)
5	Feb 12 – Feb 16	4.2 5.1	Matrix Associated with a Linear Map <b>Scalar Products and Orthogonality</b> Scalar Products	1d, 1f, 6, 8, 9 1,2,3
6	Feb 19 – Feb 21	5.2 5.4	Orthogonal Bases, Positive Definite Case Bilinear Maps and Matrices	2b, 5, 6a, 9, 10 1, 2, 5b, 5e, 6
7	Feb 26 – Mar 2	5.5 5.6	General Orthogonal Bases The Dual Space and Scalar Products	1a, 1b, 3 1,3,4,6
8	Mar 5 – Mar 9	5.7 5.8	Quadratic Forms Sylvester's Theorem	2, 3a, 3b, 3c, 3d, 4 1a, 1c, 3a, 3b
9	Mar 12 – Mar 16	7.1 7.2	<b>Symmetric, Hermitian, and Unitary Operators:</b> Symmetric Operators Hermitian Operators	1, 6, 8, 15 1, 5, 7, 11

10	Mar 19 – Mar 23	7.3 8.1	Unitary Operators <b>Eigenvectors and Eigenvalues</b> Eigenvalues and Eigenvectors	1,2,3,6 1,3,4,7
11	Mar 26 – Mar 30	8.2 8.3	The Characteristic Polynomial Eigenvalues and Eigenvectors of Symmetric Matrices	8a, 8d, 9, 10, 14
12	Apr 2 – Apr 6	8.4 8.5	Diagonalization of a Symmetric Linear Map The Hermitian Case	1, 2, 3, 11, 18, 19 1, 3, 6, 10
13	Apr 9 – Apr 13	8.6 9.1	Unitary Operators <b>Polynomials and Matrices</b> Polynomials	2,3,4,6,8,13 2,5,8,10,11,15,16,18
14	Apr 30 – May 4	9.2 10.1	Polynomials of Matrices and Linear Maps <b>Triangulation of Matrices and Linear Maps</b> Existence of Triangulation	1,2,3,4,5 1,2,5,7
15	May 7 – May 11	10.2	Theorem of Hamilton-Cayley	
16	May 14 – May 15		Catch-up	

Activity	Weight
Class Evaluation (homework, attendance, etc.)	15%
Major Exam I (Week 5-6)	20%
Major Exam I (Week 10-11)	20%
Final Exam (To be fixed)	45%

Materials for the exams are to be discussed.

### Holidays:

- Saudi Foundation Day Holiday: February 22 – 23, 2023
- Eid Al-Fitr Holiday: April 14 – 29, 2023