King Abdul Aziz University

Faculty of Science / Department of Mathematics

Title: Linear Algebra II - Math 445

Course Category: Bachelor

Winter 2020

Instructor: Dr. Jehan A. Al-bar	**Lecture:** FAR - 16881
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Course prerequisite: *Linear Algebra I*, and the desire to work really hard and independently.

Course Overview: Linear algebra is the study of linear systems of equations, vector spaces, and linear transformations. Solving systems of linear equations is a basic tool of many mathematical procedures used for solving problems in science and engineering. In this course, you will become competent in solving a system of linear equations, performing matrix algebra, calculating determinant, as well as finding eigenvalues and eigenvectors. Furthermore, you will come to understand a matrix as linear transformations relative to a basis of a vector space. Also you will study the Inner product space and explore it more generally by working on examples with polynomials in P_n and continuous functions in C [a ,b]. As an application, you will study the cross product of two vectors in space, and the least square problem. Also in this course you will learn the process of finding a basis B for a vector space V such that the matrix for T relative to B is diagonal, where T is a linear transformation on V.

Course goals: After successfully completing the course, you are expected to:

1- Apply reasoning skills in writing proofs and verifying theoretical properties of inner product spaces.
2- Find [x]_B in R^n, M_{m,n}, P_n, where [x]_B is the coordinate representation of a vector x with respect to a basis B of a vector space.
3- Find the transition matrix from the basis B to the basis B` in R^n
4- Find [x]_B` for a vector in R^n, where [x]_B` is the coordinate representation of a vector x with respect to a basis B` in R^n.
5- Determine wither a function defines an inner product on R^n, M_{n,m}, or P_n and find the inner product as defined for two vectors u, v in these spaces.
6- Find the projection of a vector onto a vector or a subspace.
7- Determine wither a set of vectors in R^n is orthogonal, orthonormal, or neither.
8- Use the Gram-Schmidt orthonormalization process.
9- Find an orthonormal basis for the solution space of a homogenous system.
10- Determine whether subspaces are orthogonal and if so find the orthogonal complement of a subspace.
11- Find the least square solution of a system Ax = b.
12- Find the cross product of two vectors u and v.
13- Find the eigenvalues and the corresponding eigenvectors of a linear transformation.
14- Find a basis B if possible for the domain of a linear transformation T such that the matrix for T relative to B is diagonal.
15- Find the eigenvalues of a symmetric matrix and determine the dimension of the corresponding eigenspace.
16- Find an orthogonal matrix P that diagonalizes a matrix A.

Course Content:

1- Coordinates & change of basis.
2- Length & dot product in R^n.
3- Inner product space.
4- Orthonormal basis; Gram-Schmidt process.
5- Least square analysis.
6- The cross product of two vectors.
7- Transition matrix & similarity.
8- Diagonalization of matrices.
9- Symmetric matrices & orthogonal diagonalization.

Grading:

Your final grade will be calculated according to the table

Exam 1 & 2	50%
report	10%
Final Exam	40%

Learning Resources:

Required Textbook	Elementary Linear Algebra, Larson & Falvo.
Electronic Materials	Some are available on www.cengage.com
Other Learning Materials	Website MIT Open coursewhere. https://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/