# MATH 443 - Applied Linear Algebra FALL 2017

**Instructor** – Amir Assadi (Room 811 van Vleck)
**Text**: Olver-Shakiban Applied Linear Algebra

**MATLAB** will be needed for HW and Midterms II, III and the Final Exam.

**Time - TuTh 1:00PM - 2:15PM**
**Place - VAN VLECK B115**

**Selected Hours** for Hands-on MATLAB Computational Lab (Times TBA, in B105)
**Grading** - Based on TWO highest grades from in-class midterms (open book, bring own laptop/calculator; each 25%), Take-Home Final (40%), and Homework (10%) [and Term-Project 10%.]

MIDTERM I Oct 10, 2017
MIDTERM II Nov16, 2017
MIDTERM III TBA

**MIDTERMS I, II & III** will be in-class. For midterms II & III, I provide a practice test to help with review of the key concepts, problem solving and technical skills that students need for successful test outcomes. The exams will be open-book, use of laptops and other computational hardware/software is allowed.

**FINAL EXAM** – Will be Take-Home. Details will be provided in-class.

## Text Chapters & Tentative Sections for Syllabus

This is an approximation and actual coverage may vary slightly. A detailed syllabus will be given out once we have a better idea of the students' backgrounds & performance.

**Part I Chapters 1 - 3 Problem-Solving using MATLAB, Review and Midterm I**. Will review the materials with emphasis on using MATLAB to numerically explore concepts related to finding eigenvalues and eigenvectors of Gram matrices; high-level and intuitive discussion of applications of linear algebra to contemporary issues in analysis of high-dimensional data, such as *reduction of dimensionality*, *compression* and *randomness*.

**HOMEWORK** –Solutions for selected HW problems will be provided. The main objective of "grading HW" is to train the students in critical thinking in the subject. The Solutions are intended to train the students to grade their HW using one form of solution, investigate alternative methods, and take advantage of learning from specific mistakes or weak points through this process.

HW will emphasize numerical calculations that use realistic data sets. Additional problems are assigned as we go along, and posted in the course pages. Exercises will use data sets from realistic applications.

## Part II Chapter 4, 5, 7, 8, selected topics from Ch 9 & 10

**Chapter 4 Least Squares Approximation**.

Reading Materials from Text –Sections 4.1-4.3 and selected topics from 4.4.

**PLEASE READ the text!** Even lectures differ somewhat, the HW will help you cover much of the materials through hands-on computation with MATLAB and realistic data sets.

**Chapter 5 Orthogonal Bases, The Gram–Schmidt Process and QR Factorization**.

READING - 5.1-5.3 and 5.5. Please read Sections 5.6. and 5.7 in the context of the HW and problem-solving sessions, as we go along. This will give you some practice with real-world situations that require you to learn new materials/background "on-line and as needed" for accomplishing the tasks at hand.

Sections 5.6 and 5.7 include Orthogonal Subspaces, Discrete Fourier Decomposition and FFT. We will emphasize "In-Class Problem-Solving" with discussion of applications such as compression and noise removal. Even though several sections will not be covered in the lecture, the HW will help you cover much of the materials through hands-on computation with MATLAB and realistic data sets. Additional problems are assigned as we go along, and posted in the course pages. Exercises will use data sets from realistic applications.

**Chapter 7 Linearity** – Linear functions and linear transformations; change of basis; affine transformations and isometry; linear systems; adjoints.

READING – Sections 7.1-7.5. Please read before coming to class!

**Chapter 8 Eigenvalues** – Eigenvalues and eigenvectors; bases of eigenvectors and diagonalization; eigenvalues of symmetric matrices;

**Chapter 8 Eigenvalues** – singular values and Principal Components Analysis (PCA), pseudo-inverse, simple dynamical systems theory. Besides the HW below, there will be hand-outs and problems using realistic data and real-world applications.

**Chapter 9** Matrix Exponential, solution of linear ODE systems

**Chapter 10, Section 10.6.** The matrix power method; iterative methods.