Spring 2019
24-282 Linear Algebra and Vector Calculus

Class	Tuesday, Thursday 3:00 PM – 4:20PM SH-214
Recitation	Wednesday 2:30 PM – 3:30 PM WH-5403
Instructor	Levent Burak Kara lkara@cmu.edu , SH-411 Office Hours: Wednesday 3:30 PM – 4:30 PM SH-411
Teaching Assistant	Holden Parks hparks@andrew.cmu.edu
Website	Carnegie Mellon University Canvas system
Textbook	Advanced Engineering Mathematics, Erwin Kreyszig, 10th Edition. ISBN-13: 978-0470458365 Older editions (7th edition onward) are also acceptable.

This course introduces the fundamentals of linear algebra and vector calculus for engineering students. The topics include vector and matrix operations, determinants, linear systems, matrix eigenvalue problems, vector differential calculus including gradient, divergence, curl, and vector integral calculus including line, surface, and volume integral theorems. Lecture and assignments will emphasize the applications of these topics to engineering problems. The content covered in 24-281 Introduction to Scientific Computing will be a part of this course. Student evaluation will include weekly homework assignments (requiring both written answers as well as Matlab code), two midterms and a final exam.

Topics to Master:

- Matrices, Vectors, Vector Spaces, Determinants, Linear Systems
- Matrix Eigenvalue Problems
- Vector Differential Calculus. Grad, Div, Curl
- Vector Integral Calculus. Integral Theorems
- Scientific Computing (Matlab) for Linear Algebra and Vector Calculus

Homework Submission Procedures:

All submissions will be through Canvas.

Programming:

While you can use any programming language you would like, no sample code or support may be available if you choose a programming language other than Matlab. You may obtain Matlab through CMU's online software repository:

http://www.cmu.edu/computing/software/all/matlab/index.html

Grading:

Each assignment will be out of 100 points. 95% of the points you attain is contingent on the correctness of your answers. 5% is reserved for organizational skills, quality of work, easy accessibility and legibility. The extra credits as usual would be added to the final score.

Late Submission Policy:

You have the option to submit your assignment after the announced deadline (started late, had to travel, computer malfunction etc.). The following policy will apply:

- Submission after the deadline, but within the first 2 hours of the deadline: Your nominal assignment grade is multiplied by 0.95.
- Submission after the deadline, but within the first 24 hours of the deadline: Your nominal assignment grade is multiplied by 0.80.
- For further delays, 10% will be deducted for additional 24-hour blocks. For example, if you submit your assignment 30 hours passed the deadline, the multiplier is 0.70. 50 hours passed the deadline; the multiplier is 0.60 etc.

Grading:

Homework (~12 assignments)	65
Midterm 1	15
Final exam	15
Attendance	4
Faculty Course Evaluation	1
Total	**100%**

Grading Scale and Description:
85%-100% = A
75%-85% = B
65%-75% = C
55%-65% = D
0%-60% = R

A note on collaboration:

For your assignments, we encourage you to collaborate with each other. However, some of you may have differing ideas of what appropriate collaboration means.

Here are some guidelines for you when it comes to collaboration:

1. Any text or graphics contained in your submissions should be solely your work. You should not use anything that was created by someone else.

2. Any code that you submit should be entirely written by you (excluding, of course, the framework we provide you).

3. To reiterate (1) and (2), you should not be cut-and-pasting from someone else, sending work via email to someone else, or having someone else type the work for you.

Here are some forms of good collaboration:

1. Discussing the implications of results with your classmates. "Hey, for this small system, my iterative solver gives worse results than my direct inversion of the matrix, but that doesn't make intuitive sense to me. What do you think?" "Yeah, my inversion is better than my iterative solver. Perhaps your code is doing <insert statement about the code> incorrectly?"

2. Asking for help conceptualizing something. "I don't get the purpose of the matrix augmentation as it relates to Gauss elimination. Do you know what it means?" "Yes, it means..."

3. Discussing theorems, principles, equations, etc. "Hey, in the proof on Problem 2a, I tried using the definition of the dot product; did you do something similar?" "Yes, I did, and I noticed that the fact that cosine is an even function make the two sides of the equation equivalent."

4. Debugging code. "My code is giving me this error. Can you come take a look?" "Sure...oh yeah, I got that error as well. You can get rid of it by using this function instead."

If you are unsure of whether or not you are participating in inappropriate collaboration, talk to the TA. We reserve the right to deduct points if cheating is suspected.

Here is a useful link to CMU's policy on the matter:
http://www.cmu.edu/academic-integrity/cheating/index.html

Module	Week	Day 1	Recitation	Day 2
Linear Algebra: Matrices, Vectors, Determinants, Linear Systems	**(W1) Jan 14**	Matrices, Vectors: Addition and Scalar Multiplication.	[Hw1 out]	Matrix Multiplication.
	(W2) Jan 21	Linear Systems of Equations. Gauss Elimination.	[Hw2 out]	Linear Independence. Rank of a Matrix. Vector Space. [Hw1 due]
	(W3) Jan 28	Solutions of Linear Systems: Existence, Uniqueness.	[Hw3 out]	*No class – Class cancelled due to winter weather* [Hw2 due]
	(W4) Feb 04	Solutions of Linear Systems: Existence, Uniqueness.	[Hw4 out]	Determinants. [Hw3 due]
	(W5) Feb 11	Determinants properties and Cramer's Rule.	[Hw5 out]	Inverse of a Matrix. Gauss–Jordan Elimination. [Hw4 due]
Linear Algebra: Matrix Eigenvalue Problems	**(W6) Feb 18**	Vector Spaces, Inner Product Spaces. Linear Transformations.	[Hw6 out],	The Matrix Eigenvalue Problem. Determining Eigenvalues and Eigenvectors. [Hw5 due]
	(W7) Feb 25	Some Applications of Eigenvalue Problems.	[Hw7 out]	*No class* [Hw6 due]
	(W8) Mar 4	Symmetric, Skew-Symmetric, and Orthogonal Matrices.		Eigenbases. Diagonalization. Quadratic Forms. [Hw7 due]
Vector Differential Calculus: Grad, Div, Curl	**(W9) Mar 11**	*No class - Spring break*	*No class - Spring break*	
	(W10) Mar 18	*No class*	[Hw8 out]	Vectors in 2-Space and 3-Space.
	(W11) Mar 25	Inner Product (Dot Product), Vector Product (Cross Product).	[Hw9 out]	Vector and Scalar Functions and Their Fields. Vector Calculus: Derivatives. [Hw8 due]
	(W12) Apr 1	Gradient of a Scalar Field. Directional Derivative.	[Hw10 out]	Curves. Arc Length. Curvature. Torsion. [Hw9 due]
	(W13) Apr 8	Divergence of a Vector Field.	[Hw11 out]	*No class - Spring carnival* [Hw10 due]
Vector Integral Calculus: Integral Theorems	**(W14) Apr 15**	Curl of a Vector Field.	[Hw12 out]	Line Integrals, Path independence. Double, triple integrals. [Hw11 due]
	(W15) Apr 22	Green's theorem in the plane.	[Hw13 out],	Surfaces for Surface Integrals. Surface Integrals. [Hw12 due]
	(W16) Apr 29	Triple Integrals. Divergence Theorem of Gauss. Stoke's theorem.	[Hw14 out],	*No class* [Hw13 due]
	(F1) May 6			Hw14 due

All homework assignments are due **Thursday 11:59pm through Canvas**. See the syllabus for the submission and late policies.