MATH-461 LINEAR ALGEBRA, (28/01/2019) SPRING 2019

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2 Textbook : *LINEAR ALGEBRA AND ITS APPLICATIONS* by D. Lay, S. Lay and J. MacDonald, 5th edition, ISBN 978-0-321-98261-2

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3 Office Hours : Tues.-Thurs. 10:00-11:00 AM, or by special appointment.

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4 Grading Policy : Out of a total of 470 points :

a) Three in class exams each 120 pts. I will drop the lowest grade. Total 240 pts.

b) Final exam, 180 pts.

c) Five MATLAB projects each 10 pts. total 50 pts.

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5 Exams : The three in class exams will take place on

EXAM # 1. FEB. 28

EXAM # 2. APRIL 4

EXAM # 3. MAY 2 ,

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6 General policy : Missed exams will not be made-up. If you miss one exam I will substitute the missed grade with the grade of your final (appropriately scaled). If you miss two exams I will give a make up only after appropriate justifications (i.e. a written note from your doctor etc).

If you cannot make it to the final exam you have to inform me at least a week in advance in order to arrange for an alternate method of examination.

Class attendance is expected.

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7 Disabilities : Students requiring special examination conditions will need to register with the office (DSS), Disabled Student Services in Shoemaker Hall and make testing arrangements with them.

Councelling center : (301)-314-HELP(4357)

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8 Calculators, Books : Calculators and Textbooks are **not allowed** during the exams.

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9 Grading scale The grading scale is:

A +: 95-100%

A : 90-94%

A- : 85-89%

B +:80-84%

B : 75-79%

B- : 70-74%

C+ : 65-69%

C : 60-64%

C- : 55-59%

D : 50-54%

F : 0-49%

I reserve the right to scale down, **but not up** the above.

1.1 Introduction, systems of linear equations.
1.2 Gaussian Elimination (row readuction) and Gauss-Jordan Elimination.
1.3 Vector Equations (notation) Vector spaces $\mathbf{R}^n$ and vector operations. Matrix notation, the product $A\mathbf{x}$ and the equation $A\mathbf{x} = \mathbf{b}$.
1.4 Solution sets and the row reduced echelon form.
1.5 Linear maps between vector spaces, $T : \mathbf{R}^n \mapsto \mathbf{R}^m$.
1.6 The product $A\mathbf{x}$ as a linear combination of columns of A.
1.7 Linear Independence of vectors.
1.8 Some Applications.
• Recommended problems :
1.1 # 11, 23, 24, 25
1.2 # 2, 3, 4, 7, 13, 27
1.3 # 20, 24, 26, 27, 25
1.4 # 9, 11, 12, 21, 23, 25, 28, 32
1.5 # 7, 10, 29, 31, 36, 38
1.6 # 4, 6
1.7 # 11, 21, 32, 33
1.8 # 3, 10, 19, 21, 22, 35
1.9 # 5, 7, 15, 16, 23
Ch. 1 suppl. : 5, 6, 8, 11, 23, 24

2.1 Matrix operations, matrix multiplication and matrix algebra.
2,2 Basic properties of Matrix Operations.
2.3 The inverse of a Square Matrix. The transpose of a matrix.
2.4 Elementary row Operations the $L-U$ and $L-D-U$ factorization. Matrix factorization.
2.5 Partitioned Matrices
2.6 Subspaces of $\mathbf{R}^n$.
2.7 Dimension and rank.
2.8 Some applications, Markov Chains, Leontief Input-Output model.
• Recommended Problems :
2.1 # 5, 9, 10, 15, 16, 17, 26, 36, 39
2.2 # 7, 9, 10, 17, 21, 29, 31, 41
2.3 # 7, 13, 20, 27, 31, 33, 39, 40, 41, 44
2.4 # 1, 3, 12, 15, 18, 19, 20, 21, 24
2.5 # 2, 5, 7, 11, 17, 18, 19

2.6 # 5, 7, 9, 11
2.7 # 5, 6, 11, 13, 21
2.8 # 8, 10, 11, 15, 16, 22
2.9 # 2, 4, 13, 15, 19, 21, 23
Ch. 2 suppl. # 3, 8, 9, 11, 13

3.1 The Determinant of a matrix and its basic properties.
3.2 Properties of determinants.
3.3 How to compute the determinant.
3.4 The geometric meaning of the determinant.
• Recommended Problems :
3.1 # 12, 20, 21, 39
3.2 # 1, 2, 3, 19, 24, 27, 29, 34, 35, 40, 43
3.3 # 24, 27, 31
Ch. 3 suppl. # 9, 10, 13, 16, 17

4.1 Vectors spaces and subspaces. The concept of a subspace.
4.2 Linear transformations, null space, column space and rank.
4.3 Linearly independent sets and bases.
4.4 Coordinate systems and change of basis.
4.5 Dimension of a vector space.
4.6 Rank
4.7 Applications.
• Recommended Problems :
4.1 # 2, 3, 11, 12, 24, 32, 33, 34
4.2 # 2, 3, 5, 7, 9, 11, 25, 26, 33, 39
4.3 # 1, 9, 11, 17, 19, 23, 24, 31
4.4 # 1, 2, 11, 14, 21
4.5 # 3, 19, 21, 22, 29
4.6 # 3, 4, 5, 8, 14, 21, 24, 27
4.7 # 5, 6, 15
4.8 # 13, 15, 17, 25, 29
4.9 # 5, 8, 18, 19
Ch. 4 suppl. # 1, 12, 13

5.1 Eigenvectors and Eigenvalues
5.2 The chracteristic polynomial, roots and multiplicity

5.3 Diagonalization
5.4 Similar matrices
5.5 Complex eigenvalues
5.6 Some Applications.
• Recommended Problems :
5.1 # 2, 3, 6, 7, 15, 19, 21, 22, 30, 33
5.2 # 3, 5, 11, 18, 20, 21, 23, 24, 25
5.3 # 3, 5, 15, 21, 22, 26, 27, 28
5.4 # 1, 6, 8, 10, 13, 19, 21, 22, 23
5.5 # 2, 3, 8, 23, 24
5.6 # 1, 2, 3
Review # 1, 2, 5, 6, 12, 14, 19, 22, 23

6.1 Inner product, norm and orthogonality
6.2 Orthogonal projections
6.3 Gram-Schmidt and the QR factorization
6.4 Lest squares
6.5 Applications

• Recommended Problems :
6.1 # 1, 3, 9, 14, 20, 22, 27, 30
6.2 # 2, 4, 11, 13, 17, 24, 29, 30
6.3 # 1, 3, 5, 8, 11, 17, 21, 22
6.4 # 2, 4, 5, 8, 13, 17, 19, 20
6.5 # 1, 3, 5, 10, 15, 17, 18, 19
6.6 # 1, 2, 6, 14
Supplementary exercises # 1, 3, 4, 7, 8

7.1 Symmetric matrices
7.2 Quadratic forms
7.4 Singular value decomposition
• Recommended Problems :
7.1 # 1, 11, 16, 19, 23, 24, 25, 26, 30
7.2 # 1, 2, 3, 6, 9, 12, 17, 21, 22, 26, 27, 28
7.4 # 1, 2, 3, 6, 8, 12, 13, 15, 16, 17, 20, 22, 24, 26, 27