SYLLABUS

MTH 365/465 – Numerical Linear Algebra

Spring 2018

Instructor: Dr. Sofya Chepushtanova

- Email: sofya.chepushtanova@wilkes.edu
- Office: Stark Learning Center (SLC) 410. Phone: (570) 408-4868

- Class webpage: http://chepusht.mathcs.wilkes.edu/numerical-linear-algebra-sp2018

Class Meetings:

- MWF 12:00-12:50am, room SLC 411 (and SLC 409 for labs)

Office Hours: MWF 10:00-10:50am and 2:00-2:50pm or by appointment, SLC 410.

Course Description and Objectives: This course provides an introduction to numerical linear algebra, the study of algorithms for finding numerical solutions of linear algebra problems.
Topics include direct and iterative methods for the solution of systems of linear equations, matrix decompositions (or factorizations), computation of eigenvalues and eigenvectors, relaxation techniques, the theoretical basis for error analysis, including vector and matrix norms, applications such as least squares and finite difference methods.

Students completing this course should be able to:

- Understand the basics concepts of stability and conditioning of a linear system.
- Perform certain matrix decompositions.
- Solve small size linear systems by hand, and larger size ones by using certain computer software.
- Understand the iterative techniques (such as Jacobi and Gauss-Seidel methods).
- Solve eigenvalue problems.
- Solve least square problems.
- Use finite difference method to solve two-point boundary value problem.

Prerequisites: An elementary course in linear algebra (MTH 214 or its equivalence) and programming experience (CS 125 or its equivalence).

Textbook: *Numerical Methods: Design, Analysis, and Computer Implementation of Algorithms* by Anne Greebaum and Timothy Chartier, Princeton University Press, 2012. (more details are here: http://press.princeton.edu/titles/9763.html).

Other Useful References:

1. Biswa Nath Datta, *Numerical Linear Algebra and Applications*, second edition, SIAM, 2010.
2. Gilbert Strang, *Linear Algebra and Its Applications*, third edition, International Thompson Publishing.
3. Carl D. Meyer, *Matrix Analysis and Applied Linear Algebra*, SIAM, Philadelphia, 2000.
4. James W. Demmel, *Applied Numerical Linear Algebra*, SIAM, Philadelphia, 1997.
5. Gene H. Golub and V. Van Loan, *Matrix Computations*, third edition, John Hopkins U. Press, Baltimore, 1996. (*This is the bible of numerical linear algebra. Advanced text.*)
6. Lloyd N. Trefethen and David Bau, III, *Numerical Linear Algebra*, SIAM, Philadelphia, 1997. (*A very clearly written, advanced text.*)
7. Lars Eldén, *Matrix Methods in Data Mining and Pattern Recognition*, SIAM, Philadelphia, 2007. (*A good textbook with engineering applications.*)

Attendance: You are expected to attend classes regularly. If you skip a class, it is your responsibility to catch up any missed material, find out any announcements made during the class, and make sure your homework turned in on time.

Homework: Homework problems will be assigned for each topic covered. Start working on assigned problems as soon as the corresponding sections are covered. Access to MATLAB is required to do computational homework assignments.

You are encouraged to type your solutions using TEXor LATEX, the standard in mathematical typesetting. There are versions available for you to use in the department labs. See our course webpage for tutorial and example links.

Graduate Student Presentations: Each MTH 465 student will deliver a 20-25 minute presentation at the end of the semester.

Exams and Grade Distribution: There will be three in-class one-hour examinations and a comprehensive take-home final examination. Make-up examinations will not be allowed except for extreme circumstances. It is the students responsibility to contact the instructor if an emergency situation occurs. Notice of the emergency should be made in a timely fashion and proper documentation will be required.

MTH 365 student's final score in this course will be calculated as follows:
Homework 20% + Best Exam (22%) + Median Exam (18%) + Worst Exam (15%) + Final Exam (25%) = 100%.

MTH 465 student's final score in this course will be calculated as follows:
Homework 15% + Presentation 5% + Best Exam (22%) + Median Exam (18%) + Worst Exam (15%) + Final Exam (25%) = 100%.

The final grade will be computed from the total percentage earned as follows:

Percentage	*Grade*
90 – 100%	4.0
85 – 89%	3.5
80 – 84%	3.0
75 – 79%	2.5
70 – 74%	2.0
65 – 69%	1.5
60 – 64%	1.0
< 60%	0.0

Drop Policy: If you wish to drop from the course, I will give my permission during the first ten weeks of the semester. Thereafter you will need the permission of the Dean. Be aware that poor performance in the course will not be a sufficient reason for the Dean's permission to be granted.

Academic Honesty: By handing in homework, quizzes, and exams you certify that this is your own work. You are encouraged to discuss homework solution strategies with fellow students but the final write-up must be your own. A violation will result in a grade of zero on that particular assignment; serious or repeated infractions of the Academic Honesty policy will result in failure of the course.

Cell Phones should be switched to silent mode (or turned off), and put out of sight during class time.

Tentative Class Schedule, Spring 2018 (Dates are Subject to Change)

1. Week of 1/15: Introduction to NLA. Review of important concepts in linear algebra.
2. Week of 1/22: Floating point arithmetic. Introduction to MATLAB.
3. Week of 1/29: Conditioning of problems; stability of algorithms.
4. Week of 2/5: Direct methods for solving linear systems: Gaussian elimination, LU factorization, Cholesky decomposition.
5. Week of 2/12: Continue on direct methods. Exam I.

6. Week of 2/29: Vector and matrix norms, sensitivity of solutions of linear systems.

7. Week of 2/26: Least squares, normal equations, QR decomposition, fitting polynomial to data.

8. Week of 3/5: *No classes - Spring Recess 3/3 - 3/11.*

9. Week of 3/12: Continue on least squares, normal equations, QR decomposition, fitting polynomial to data.

10. Week of 3/19: Singular value decomposition (SVD).

11. Week of 3/26: Exam II. *No class on Friday - Holiday Recess 3/29 - 4/1.*

12. Week of 4/2: Iterative techniques for solving linear systems (Jacobi, Gauss-Seidel, SOR methods).

13. Week of 4/9: Continue on iterative methods.

14. Week of 4/16: Eigenvalues and eigenvectors. The power method, inverse and QR algorithm.

15. Week of 4/23: Continue on eigenvalues. Review and Exam III.

16. Week of 4/30: Course summary. MTH 465 students present a lecture on finite difference method for the two-boundary value problem. *Wednesday 2/5, last day of class, follows Friday schedule.* Final Exams begin on Thursday, 5/3.

17. Week of 5/7: Take-home final exam, due time and date: TBD.