SYLLABUS: EP 501, Fall 2019

Numerical Methods
Embry-Riddle Aeronautical University
Daytona Beach Campus

Instructor: Dr. Matthew Zettergren ("Matt" or "Dr. Z")

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- **web:** Canvas and GitHub (https://github.com/mattzett/EP501)
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- **office hours:** Th, 3-5pm; and by appointment (schedule more than 24 hours in advance)

Lecture times and rooms: T/Th, COAS 203, 11:15am-12:30pm

Required text: *Numerical Methods for Scientists and Engineerings*, 2nd Ed., Hoffman, CRC Press, 2001.

Other useful references:

- *Matlab Documentation*, Mathworks, https://www.mathworks.com/help/matlab/

Prerequisites:

- Undergraduate Applied Mathematics (e.g. Infinite series, Vector calculus, ODEs, Basic matrix algebra, Complex numbers, PDEs)
- Basic programming background using Matlab or similar software.

Goals: Provide a foundational background in solution of various engineering and science problems with using numerical techniques. During this course the Matlab software and language will be used extensively.

Course Content (subject to change):

1. *Basis for Numerical Methods and Scientific Computing*
    1. MATLAB Introduction
    2. Representations of Numbers
    3. Precision, Accuracy, and Errors
    4. Basic Linear Algebra
2. *Numerical Linear Algebra*
    1. Direct Elimination

2. Tridiagonal (and other) Systems
3. Iterative Methods

3. Eigenvalue problems (if time allows)
1. Physical Examples
2. Finding Eigenvalues
3. Finding Eigenvectors

4. Nonlinear Equations
1. Methods for Finding Roots
2. Zeros of Polynomials
3. Systems of Nonlinear Equation

5. Polynomial Approximation and Interpolation
1. Polynomial Interpolation
2. Piecewise Polynomial Interpolation and Splines

6. Differentiation and Integration
1. Numerical Integration (Quadrature)
2. Taylor Series
3. Numerical Differentiation

7. Methods for ODEs:
1. Classifications and Physical Examples
2. Methods for Initial Value Problems
3. Methods for Boundary Value Problems

8. Methods for PDEs:
1. Classifications and Physical Examples
2. Methods for Elliptic Problems (Laplace / Poisson)
3. Methods for Parabolic Problems (Heat / Diffusion)
4. Methods for Hyperbolic Problems (Advection / Wave)

Grading (*subject to change*):

40% Homework
30% Mid-term Exam
30% Final Exam

"**A**": 90-100%
"**B**": 80-89%
"**C**": 70-79%
"**D**": 60-69%
"**F**": 0-59%

Homework: Homework assignments will be posted on CANVAS and will include both computational task and analytical calculations or derivations.

1) Homework assignments are to be submitted as a combination of PDF and matlab source code files on CANVAS.
2) Written parts of homework assignments must by either typeset (using e.g. Pages, Word, or LaTeX) and converted to PDF format (all of these programs include tools to convert to a PDF) or handwritten and scanned in to PDF.
3) You must submit functioning source code for each assignment, and all code must be in a single Matlab .m source file.

4) Include, as a PDF, a published version of your Matlab code and its results with your submission.
5) You must cite all external sources used to complete your homework
6) You must document, in your submitted homework, any collaborations with other students in the class.
7) All solutions must be numerical - you may not use symbolic math software (or Matlab symbolic toolboxes) to work any of the problems.

Academic Integrity: Plagiarism and fraud are unacceptable in all forms, constituting serious academic integrity violations. Homework assignments will be checked to ensure that work is original and unique (i.e. not copied directly from an internet source or other student). Projects and exams completed for this class must include proper citations using a standard bibliographic format. All collaborations on assignments (where allowed - only on homework) *must be disclosed by each student involved*.

Exams: Two exams will be given during the semester, Midterm and Final. Each of these may have both an in-class and take-him portion (the specific format will be announced in class prior to the exam date). Take-home components of exams are to be done alone (i.e. without help from another person). Cite any internet or textbook source that you use to complete the exam. Always ask if you are not sure a source is appropriate for use on a take-home exam or other assignment.

Example Codes: Example codes distributed for this course are kept under version control using git and GitHub. The EP 501 repository is located at https://github.com/mattzett/EP501 (MIT license) and you are encouraged (but not required) to use git to synchronize your local copy of the course scripts to the repository, thereby getting any updates or new files that have been posted. Changes to your own work with also be marked if you are using version control so that you can easily locate your recent changes and any possible errors that you may have introduced.

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