Numerical Computing
MATH-4800 and CSCI-4800
Fall 2022

Instructor: Mark H. Holmes
RPI Email: holmes
Office: Amos Eaton 322
Office Hours: W 4-5, Tr 2-3

Grader: (removed)
RPI Email: (removed)

Tentative Outline

I. Fundamentals of Scientific Computing (1 week)
- a) Overview and introduction to MATLAB
- b) Floating-point representation
- c) Computer arithmetic and loss of significance

II. Nonlinear Equations (1 week)
- a) Bisection
- b) Newton's method
- c) Secant method

III. Numerical Solution of Linear Systems (2 weeks)
- a) LU factorization
- b) Error analysis, residuals and accuracy
- c) Cholesky factorization

Exam 1 (about Sept 29)

IV. Interpolation (2 weeks)
- a) Polynomial interpolation
- b) Piecewise polynomial interpolation
- c) Function approximation

V. Numerical Integration (1.5 weeks)
- a) Elementary methods
- b) Gaussian quadrature

Exam 2 (about Nov 3)

VI. Numerical Differentiation and Numerical Solution of IVPs (2 weeks)
- a) Numerical differentiation
- b) Elementary methods
- c) Runge-Kutta methods

VII. Unconstrained Optimization (2 weeks)
- a) Least squares
- b) Conjugate gradient method
- c) Nelder-Mead algorithm

Exam 3 (about Dec 8)

Piazza Course Page: https://piazza.com/class/l6z2zqhrlsd2er

Textbook: *Introduction to Scientific Computing and Data Analysis* by Mark H. Holmes

References
Numerical Analysis (3nd Ed) by Sauer
Comment: It has been used as text for the course.
Scientific Computing, an Introductory Survey (2nd ed) by Heath
Comment: Not bad, at least at the beginning, and lots of exercises (have used it for text)
Numerical Methods with MATLAB by Recktenwald
Comment: A lot is done well but there are some serious mistakes (have used it for text)
Numerical Analysis by Burden and Faires
Comment: At one time it was the most widely used text
Numerical Computing with MATLAB by Moler
http://www.mathworks.com/moler (electronic edition - this is free)

Grading
Homework: 25%, Exams: 75% (no final exam)
Comments: 1) No homework score will be dropped. 2) Grade modifiers are not used.

Piazza: This is an asynchronous Q&A discussion forum where you can ask questions about the homework, course, etc. For questions that others might be interested in, the post will be made readable by everyone in the class (the default setting is that the post is to the Instructor). Also, all pdf's and MATLAB files will be posted on our Piazza page (under Resources).

Homework: There will be regularly assigned homework, with all involving one or more coding/computational problems. These are to be turned in during class (emailed pdf files will not be accepted).

Exams: There will be 3 exams, and they will be in-class.

Grades: These will be kept on LMS.

Attendance, Course Material and Exams
In the course outline, where possible, the relevant sections of the text are indicated. Attendance is very strongly recommended as you will be responsible for any information given out in class.

Academic Integrity
Do not copy or cheat during exams. With respect to homework, you are free to seek assistance or advice from any person, book, or computer. However, what you hand in must be your own work. You are free to use the MATLAB codes provided by the instructor on Piazza, but other computer files must not be shared or exchanged. Violating this policy will result in a score of zero for the assignment. Also, all the rules and policies in the Rensselaer handbook should be followed (https://rpi.app.box.com/s/bfzzwdsrqxzrm3jikr2uv6gn7zu6dhlt).

Grade Appeals
Appeals must be made within one week of the date the item is returned in class. It is important that you keep all the returned material for the entire semester as they will be your only method for correcting any recording errors that may accidentally occur on my part.

Late Policies
Late homework is usually not accepted without a legitimate excuse. Missing an exam without a legitimate excuse results in a grade of zero and cannot be made up. For example, if you are too ill to come to class, you will need a doctor's, or an Office of Student Experience (https://success.studentlife.rpi.edu/current-students/academic-and-personal-support/requesting-excused-absence) note to be excused.

COVID Complications: Anyone who must quarantine will still be required to submit any HW, or take any missed exam(s), but on a modified schedule (which will be worked out on an individual basis).