

Math/CPSC 402: Numerical Analysis

Spring 2012

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Office Hours: Mon, Wed: 2:30 – 3:30 pm
Tu, Th: 1:30 – 3:00 pm
Also by appointment or drop-in

Text: *Numerical Analysis (9th Edition)* by Richard L. Burden and J. Douglas Faires. Brooks/Cole Cengage Learning, 2011.

Course Objectives: Numerical Analysis is the study of numerical approximation techniques. In many ways it is the study of how to get the computer to do mathematics accurately! The computer is finite and discrete, and much of mathematics is infinite and continuous; hence, to get the computer to do mathematics approximations are necessary. Furthermore, many mathematical problems (such as some integration problems) do not have closed form solutions; again, approximation is necessary. This course introduces the concepts and techniques of the design, implementation, and analysis of numerical algorithms for solving equations, approximating functions, solving systems of linear equations, differentiating functions, and integrating functions. Additional topics, such as solving differential equations, will be included as time allows. A tentative list of chapters covered in the textbook (in the order given) is as follows:

- Chapter 1: Mathematical Preliminaries and Error Analysis
- Chapter 2: Solutions of Equations in One Variable
- Chapter 3: Interpolation and Polynomial Approximation (Selected Sections)
- Chapter 6: Direct Methods for Solving Linear Systems
- Chapter 7: Iterative Techniques in Matrix Algebra (Selected Sections)
- Chapter 9: Approximating Eigenvalues (Selected Sections)
- Chapter 4: Numerical Differentiation and Integration (Selected Sections)

Intended Learning Outcomes: At the end of the course, a successful student will be able to

- describe the basic concepts of truncation error, round-off error, stability, and convergence rate (convergence order) and their importance in assessing numerical algorithms
- describe how the computer stores and manipulates floating point numbers
- anticipate errors that may arise from computer arithmetic and be able to determine ways to perform calculations to minimize the errors
- describe and apply several standard algorithms for solving equations (Newton's method and other iterative methods), for function approximation (such as Lagrange's Polynomial and Cubic Splines), for solving systems of linear equations (Gaussian elimination with various pivoting strategies, iterative methods), for approximating eigenvalues (the Power Method), for differentiating (forward difference, backward difference, adding extra points), for integration (various quadrature methods, Romberg)
- analyze the error involved in numerical approximation algorithms.

Attendance Policy: Class attendance is a very important aspect of a student's success in this course. The student is expected to attend every class and is accountable for any missed classes.

Grading Policy: The grade in this course will be based on 3 in-class tests, homework assignments, a co-curricular requirement, and a comprehensive final examination.

The weight given to each of these in determining the final grade is as follows:

Tests (17% each)	51%
Assignments	24%
Co-Curricular	3%
Final Exam	22%

Test Dates:	Test #1	Wednesday, February 15
	Test #2	Wednesday, March 21
	Test #3	Wednesday, April 18
	Final Exam	Wednesday, April 25 (8:30 – 11:30 a.m.)

Grading Scale:	93-100...A	83-86...B	73-76...C	63-66...D
	90-92....A-	80-82...B-	70-72...C-	60-62....D-
	87-89....B+	77-79...C+	67-69...D+	below 60..F

Homework/Assignments: The assignments in this course will involve a combination of "paper and pencil" exercises and computer exercises. Computer exercises will involve some programming in a high level language (C++ or Java) and some experimentation with and exploration of existing programs (Mathematica, spreadsheet software, handheld calculators). There will routinely be "turn in" problems (often from the text) to be turned in for a grade in addition to other problems that are to be done but not turned in. Assignments to be turned in are due at the beginning of class on the due date (which occasionally may be the next class period after they are assigned) unless otherwise specified. Assignments will vary in size and difficulty; some may involve group work. Students may discuss problems and work together on solutions and programs but in all cases each student must write up his/her final solutions/programs independently (no copying!). Most work will not be accepted late; in the cases that late work is accepted there will be a 10% per day penalty and will not be accepted after 3 days.

Co-Curricular Requirement: The Department of Mathematics, Computer Science, and Physics is offering a series of lectures designed to engage the campus community in discussions of ongoing research, novel applications, and other issues that face these disciplines. You are invited to attend all of the events but participating in **at least three** is mandatory. Within one week of attending an event you must submit a one page, single-spaced, paper (to Inquire) reflecting on the discussion. If you do not turn the paper in within the one week time frame you may not count that event as one you attended.

Make-up Policy: Everyone is expected to take tests and the exam at the scheduled time. Make-ups will be given only for legitimate, documented absences and, if given, may be oral. A grade of zero is given for a test that is missed but not made up.

Academic Integrity: Students are expected to adhere to the Academic Integrity policies of Roanoke College. All work submitted for a grade is to be strictly the work of the student unless otherwise specified by the instructor. The policies as outlined in the Academic Integrity handbook will be strictly enforced in this course.

Electronic Devices: Cell phones and other electronic devices must be turned off prior to entering the classroom. The use of any electronic device during a test is strictly prohibited; any such use will be considered a breach of academic integrity

Special Needs: If you are on record with the College's Office of Disability Support Services as having special academic or physical needs requiring accommodations, please meet with me as soon as possible. We need to discuss your accommodations before they can be implemented. If you believe you are eligible for accommodations but have not yet formally contacted the Office of Disability Support Services please do so. Contact Ms. Barbara Awbrey, Coordinator for Disability Support Services, at 375-2247 or drop by the Center for Learning and Teaching in Fintel Library.