MATH-UA 252 – Numerical Analysis

Fall 2021 Syllabus

Logistics

Lecture Times: TR 11:00am – 12:15pm,
Building: 7E12, Room: LL23

Instructor: **Nicholas Boffi** – boffi@cims.nyu.edu
Office Hours: Thursday, 3:00-4:30pm, CIWW 922

Text: Chartier, T. P. and Greenbaum, A. "Numerical Methods: Design, Analysis, and Computer Implementation of Algorithms" (2012)
PDF available for free via the NYU Library

Grading: Homework (15%), Midterm 1 (25%), Midterm 2 (25%), Final exam (35%)
DO NOT BOOK TRAVEL FOR BEFORE THE FINAL EXAM DATE!!!

Course Description

An introduction to numerical analysis (the algorithms of continuous mathematics). We will cover classical and modern topics, including Monte Carlo methods, the solution of linear and nonlinear equations, floating point arithmetic and roundoff error, conditioning, interpolation, quadrature, numerical differentiation, numerical methods for ordinary differential equations, and the computation of eigenvalues.

The course will cover the analysis of numerical methods, but the homeworks will also have an implementation component.

Course Prerequisite

MATH-UA 123 Calculus III or MATH-UA 213 Math for Economics III (for Economics majors) with a grade of C or better and/or the equivalent, and MATH-UA 140 Linear Algebra or MATH-UA 148 Honors Linear Algebra with a grade of B or better.

Exam policy

No notes, calculators, phones, etc. are allowed during exams.

Homework policy

Homework will be assigned weekly via Brightspace. Completed assignments will be uploaded **in pdf form only** to Gradescope. **Programming assignments must be written in Python.**

Late homework will **not** be accepted, but the two lowest homeworks will be dropped.

You may discuss with other students with the following restrictions:

- You must make an honest attempt at homework problems before discussing them with anyone else.
- You must **do the final write-up independently in your own words**
- You may compare final answers with others to check for mistakes.
- If you receive substantial help on a problem, **you must acknowledge it**. This will not result in any penalty.

Tentative Schedule

Week	Date	Topics	Chapters	HW due
1	Sept. 2	Basic statistics.	3.1, 3.2	
2	Sept. 7	Monte Carlo integration.	3.2, 3.3	
	Sept. 9	Bisection search. Taylor's theorem.	4.1, 4.2	
3	Sept. 14	Newton's method.	4.3, 4.4	HW1
	Sept. 16	Fixed point iterations.	4.5, 4.6	
4	Sept. 21	Roundoff errors and floating point arithmetic.	5.1-5.3	HW2
	Sept. 23	Roundoff errors and floating point arithmetic (cont.)	5.4-5.6	
5	Sept. 28	Conditioning and stability.	6.1-6.3	HW3
	Sept. 30	Gaussian elimination.	7.1, 7.2	
6	Oct. 5	LU factorization and pivoting.	7.2	HW4
	Oct. 7	Conditioning of linear systems. Stability of GE.	7.4, 7.5	
7	Oct. 12	No class (fake Monday)		
	Oct. 14	Midterm I	3-6	
8	Oct. 19	Least squares.	7.6	HW5
	Oct. 21	Vandermonde system. Lagrange interpolation.	8.1, 8.2	
9	Oct. 26	Newton interpolation. Interpolation error.	8.3, 8.4	HW6
	Oct. 28	Chebyshev interpolation and splines.	8.5, 8.6	
10	Nov. 2	Numerical differentiation and Richardson extrapolation.	9.1, 9.2	HW7
	Nov. 4	Newton-Cotes and piecewise polynomial integration.	10.1, 10.2	
11	Nov. 9	Gauss and Clenshaw-Curtis quadrature.	10.3, 10.4	HW8
	Nov. 11	IVPs and Euler's method.	11.1-11.2.1	
12	Nov. 16	Midterm II	7-10	
	Nov. 18	Taylor, midpoint, and quadrature methods.	11.2.2-11.2.4	
13	Nov. 23	Runge Kutta methods.	11.2.5, 11.2.7	HW9
	Nov. 25	No class - Thanksgiving		
14	Nov. 30	Eigenvalue problems. Power method, inverse iteration.	12.1.1, 12.1.2	HW10
	Dec. 2	QR factorization.	12.1.3	
15	Dec. 7	Iterative methods for linear systems.	12.2	HW11
	Dec. 9	Iterative methods for linear systems (cont.)	12.2	
16	Dec. 14	Bonus material.		
	Dec. 21	Final Exam (12pm – 1:50pm)		