Department of Mathematics & Statistics
Concordia University

MAST 334
Numerical Analysis
Fall 2023

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Class Schedule: Wednesdays, 17:45-20:15.

Office Hours: TBA.

Objectives: Numerical analysis deals with algorithms for the approximate solutions of mathematical problems whose exact solution is either impossible or unreasonably complicated. Lying at the intersection of mathematics and computer science, numerical analysis is a key component of modern scientific computing and its countless applications. In this course, students will learn how to solve problems such as solving nonlinear equations, numerical differentiation and integration, and approximating functions from data. Considerable emphasis will be given to the theoretical foundations of numerical methods, including the concepts of error analysis, best approximation, and the trade-off between accuracy and computational complexity. Theoretical lectures will be complemented by numerical illustrations in Python.

Textbooks: ***1) Numerical Analysis***, by Richard L. Burden, J. Douglas Faires and Annette M. Burden, 10th Edition, Cengage, 2016.
(The 9th Edition of the textbook is also appropriate)
E-textbook: https://www.cengage.uk/c/numerical-analysis-10e-burden-faires-burden/9781305253667/
The digital version of the textbook will be available at:
https://www.co-opbookstore.ca/service/textbooks/
The print version of the textbook will be available at:
https://www.bkstr.com/concordiastore/home

2) Python Programming and Numerical Methods: A Guide for Engineers and Scientists, by Q. Kong, T. Siauw and A. Bayen , 1st Edition, Academic Press, 2020.
eBook freely available at https://pythonnumericalmethods.berkeley.edu/

Note: Students should order textbooks as early as possible, especially for print versions in case books are backordered or there are any shipping delays.

Assignments: Assignments are very important as they indicate the level of difficulty of the problems that students are expected to solve and understand independently. Students are encouraged to use a programming language of their choice to complete the most computationally intensive problems in the assignments (e.g., Python, Matlab, Octave, R, Maple, Mathematica, Excel). Students are expected to submit assignments via Moodle. **Late assignments will not be accepted.**

Midterm Test: There will be one in-person midterm test in week 8.

PLEASE NOTE: It is the Department's policy that tests missed for any reason, including illness, cannot be made up. If you miss a test, the Final Exam will count for 90% of your final grade.

Final Examination: At the end of the course, there will be a 3-hour closed book final examination.

PLEASE NOTE: Students are responsible for finding out the date and time of the final exam once the schedule is posted by the Examination Office. Any conflicts or problems with the scheduling of the final exam must be reported directly to the Examination Office, **not** to your instructor. It is the Department's policy and the Examination Office's policy **that students are to be available until the end of the final exam period. Conflicts due to travel plans will not be accommodated.**

Final Grade: The highest of the following: (10% assignments + 20% midterm test + 70% final exam) or (10% assignments + 90% final exam).

If the grading scheme for this course includes graded assignments, a reasonable and representative subset of each assignment may be graded. Students will not be told in advance which subset of the assigned problems will be marked and should therefore attempt all assigned problems.

Calculators: Only calculators approved by the Department (with a sticker attached as proof of approval) are permitted for the class test and final examination.
For a list of Approved calculators see http://www.concordia.ca/artsci/math-stats/services.html #calculators.

Plagiarism: Cases of plagiarism (including the assignments, the mid-term test, and the final exam) will be treated according to the University policy.

Week	Sections	Topics
1	1.1	Review of Calculus
	1.2	Round-off Errors and Computer Arithmetic
	1.3	Algorithms and Convergence
2	2.1	The Bisection Method
	2.2	Fixed-point Iteration
3	2.3	Newton's Method and Secant Method
	2.4	Error Analysis for Iterative Methods
4	2.5	Accelerating Convergence (Aitken's and Steffensen's Methods)
	3.1	Interpolation and Lagrange Polynomial
5	3.5	Cubic Spline interpolation
	8.1	Discrete Least Squares Approximation
6		**Midterm Test (on material from weeks 1-4)**
	8.2	Orthogonal Polynomials and Least Squares Approximation
7	8.3	Chebyshev Polynomials and Economization of Power Series
8	8.5	Trigonometric Polynomial Approximation
	8.6	Fast Fourier Transform
9	4.1	Numerical Differentiation
	4.2	Richardson's Extrapolation
10	4.3	Elements of Numerical Integration
	4.4	Composite Numerical Integration
11	4.7	Gaussian Quadrature Formulas
	5.1	The Elementary Theory of Initial-Value Problems
12	5.2	Forward Euler's method
	5.11	Backward Euler's method

Academic Integrity and the Academic Code of Conduct

This course is governed by Concordia University's policies on Academic Integrity and the Academic Code of Conduct as set forth in the Undergraduate Calendar and the Graduate Calendar. Students are expected to familiarize themselves with these policies and conduct themselves accordingly. "Concordia University has several resources available to students to better understand and uphold academic integrity. Concordia's website on academic integrity can be found at the following address, which also includes links to each Faculty and the School of Graduate Studies: https://www.concordia.ca/conduct/academic-integrity.html" *[Undergraduate Calendar, Sec 17.10.2]*

Behaviour

All individuals participating in courses are expected to be professional and constructive throughout the course, including in their communications.

Concordia students are subject to the Code of Rights and Responsibilities which applies both when students are physically and virtually engaged in any University activity, including classes, seminars, meetings, etc. Students engaged in University activities must respect this Code when engaging with any members of the Concordia community, including faculty, staff, and students, whether such interactions are verbal or in writing, face to face or online/virtual. Failing to comply with the Code may result in charges and sanctions, as outlined in the Code.

Intellectual Property

Content belonging to instructors shared in online courses, including, but not limited to, online lectures, course notes, and video recordings of classes remain the intellectual property of the faculty member. It may not be distributed, published or broadcast, in whole or in part, without the express permission of the faculty member. Students are also forbidden to use their own means of recording any elements of an online class or lecture without express permission of the instructor. Any unauthorized sharing of course content may constitute a breach of the Academic Code of Conduct and/or the Code of Rights and Responsibilities. As specified in the Policy on Intellectual Property, the University does not claim any ownership of or interest in any student IP. All university members retain copyright over their work.

Extraordinary circumstances

In the event of extraordinary circumstances and pursuant to the Academic Regulations the University may modify the delivery, content, structure, forum, location and/or evaluation scheme. In the event of such extraordinary circumstances, students will be informed of the change.