Math 4NA3 **Numerical Methods for Differential Equations** Winter 2018

Dr. M. R. Grasselli

Lectures: Tuesdays, Wednesdays, Fridays - 12:30 to 1:20 in Hamilton Hall 305

Office: HH 415, Tel: x23406
Email: `grasselli@math.mcmaster.ca`
Course website: `Avenue to Learn`
Office hours: Tue,Wed, Fri - 1:30 to 2:30

Purpose of the course

Differential equations are ubiquitous in mathematics, physical and social sciences, and engineering. In addition to a solid understanding of their theoretical properties, most applications of differential equations require a numerical solution. This course builds up on the foundational concepts introduced in Math 3N03 (Numerical Linear Algebra) by focusing on methods specifically developed for solving differential equations numerically. These include traditional methods such as Runge-Kutta solvers and finite- difference methods, but also more advanced spectral and finite elements methods. Examples from physics, economics, and climate science will be used throughout the course, and hands-on programming with MatLab will be systematically developed. The course will also covers aspects of numerical interpolation and approximation, which are pertinent to differential equations but also relevant for other applications, notably machine learning and data science.

If you are not familiar with `matlab`*, you should spend the first week or so making sure you understand the basics of the graphical interface, programming and graphics. This will make it much easier to complete the assignments and practices concepts we cover in class. .*

Text

The primary text for the course is the *Numerical Mathematics, 2nd edition* by M.R. Grasselli & D.E. Pelinovsky (Math 4NA3 Courseware), available from the Bookstore.

Supplementary texts:

A guide to Matlab (e-book)

In addition, there are numerous introductory texts on numerical analysis available in the Thode Library at call number QA 297.

Software

Student edition of Matlab. We highly recommend that you buy this software. `matlab` is an essential part of this course, and will be very useful in any future mathematically intensive courses. Of course, you will also be able to use `matlab` in the University's computer labs.

If you don't have `matlab` on your computer and don't want to buy the student version you can also use `Octave` https://www.gnu.org/software/octave/ which is very similar.

Outline

The course is organized as follows (note that timings and content are tentative). Chapters refer to the courseware.

1. **Polynomial Approximation** (Chapter 6 - 6 lectures)
2. **Numerical Calculus** (Chapter 7 - 8 lectures)
3. **Initial-Value Problems** (Chapter 8 - 7 lectures)
4. **Boundary-Value Problems** (Chapter 9 - 11 lectures)
5. **Advanced Numerical Methods** (Chapter 10 - 4 lectures)

Evaluation

There will be five assignments, one mid-term test, and a final exam.

Assignments

Five problem sheets will be given and marked for credit. Each assignment will have a significant Matlab component. Assignments are to be handed at the start of lecture on the due date. No late assignments will be accepted. Solutions to assignments and the test will be posted on the course webpage. The tentative assignment schedule is as follows:

Assignment posted	**Assignment due**
January 10	January 26
January 26	February 14
February 14	March 2
March 2	March 21
March 21	April 06

Test

There will be one 50 minute test (during the regular class time):

Friday, February 16, 12:30 to 1:20 in HH 305 (tentative)

Final exam

There will be a 2.5-hour final examination during the December examination period. Only standard McMaster University calculators (Casio FX-991) may be used in the final examination.

Grading system

The final mark will be calculated as follows:

Assignments	40%
Test	20%
Final exam	40%

If you MSAF an assignment or the test, the marks will be shifted to the final exam (resulting in a final worth 48% of your final grade for a missed assignment and 60% of your final grade for a missed test).

I reserve the right to change the weight of any portion of this marking scheme. If changes are made, your grade will be calculated using the original weightings and the new weightings, and you will be given the higher of the two grades. At the end of the course the grades may be adjusted but this can only increase your grade and will be done uniformly. I will use the grade equivalence chart in the university calendar to convert between letter grades, grade points and percentages.

Important message

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

Official notices

Academic integrity

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at www.mcmaster.ca/academicintegrity.

The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations.

Academic accommodation of students with disabilities language for course outlines

Students who require academic accommodation must contact Student Accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contacted by phone 905-525-9140 ext. 28652 or e-mail sas@mcmaster.ca. For further information, consult McMaster University's Policy for Academic Accommodation of Students with Disabilities.

Absences and missed work (MSAF)

In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

Please follow this link for more information.