MA 780: Numerical Analysis II

Lecture details

Instructor:	Alen Alexanderian
Lecture time/location:	9:35AM-10:25AM MWF, SAS1218
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Office Hours:	12:00–1:00 Wed or by appointment; office hours will be conducted via zoom (zoom link)

Course Description

This course is continuation of MA580 and is one of subjects of the qualifying exams for Ph.D. candidates in Mathematics. The topics covered in the course include approximation and interpolation of functions, numerical differentiation and integration, and methods for numerical solution of ordinary differential equations (ODEs). Time permitting, we will also discuss some special topics such as integration, interpolation with sparse grids, numerical optimization, etc.

The basic outline of the course will be as follows: (1) Mathematical preliminaries; (2) approximation and interpolation; (3) numerical differentiation and integration; (4) ODEs: initial value problems; (5) ODEs: boundary value problems; (6) special topics.

Textbook

Gautschi, Walter. Numerical analysis, 2nd edition, 2011.

Other recommended literature

Kendall E. Atkinson, An Introduction to Numerical Analysis, second edition, Wiley, 1989.

Kendall E. Atkinson, Elementary Numerical Analysis, second edition, Wiley, 1993.

David Kincaid and Ward Cheney, Numerical Analysis, Brooks/Cole, 1996.

James M. Ortega. Numerical analysis: A Second Course, volume 3 of Classics in Applied Mathematics. SIAM, second edition, 1990.

Grading Policy

The grading will be assigned on a 10-point scale: **A: 90 – 100, B: 80 – 89, C: 70 – 79, D: 60 – 69, F: $\leq$ 60.** The cutoffs for the $+/-$ grades are determined at the end of the semester. Your final grade in this course will be determined by marks earned on about 5 homework assignments, involving a mix of theory and computational experiments (55%), a midterm exam (15%), and a final exam (30%).

Midterm exam date: Friday Mar 11

Final exam date: Friday, April 29, 8:30–11:00AM (at the usual classroom).

Homework The homework is weighted so heavily, because it includes the computational and theoretical exercises that are essential to understanding the course material. Also, an important part of your education at this stage is to learn how to present your results in the form of a professional-grade typeset report. Label each problem clearly, label equations as necessary, and produce high quality and easy to understand figures (use axis labels, captions, etc.) using for example Matlab. I encourage you to typeset your homework solutions in Latex (I will provide Latex source files for the homeworks). You must show complete work to receive full credit. This means that you should provide sufficient details such that others with similar background as yourself can reproduce your results.

Prerequisites

Calculus I-III, MA580, some background in linear algebra and ODEs, and some programming experience (I recommend Matlab, but python, as well as C or Fortran can be used also).

S/U Grading: If you are registered for use the S/U grading option, you will need to complete the course and receive at least a C– to pass the course.

Auditing the Course: To audit the course, you must have the approval of your advisor and the Mathematics Department. To receive an AU, you must attend the majority of the sessions, and you must hand in all of the homework and take all of the tests. See:

`https://policies.ncsu.edu/regulation/reg-02-20-04/`

for more information concerning course audits.

Incomplete Grades: Incomplete grades will be handled on an individual basis. Note, however, that if an extended deadline is not authorized by an instructor or department, an unfinished incomplete grade will automatically change to an F after either (a) the end of the next regular semester in which the student is enrolled (not including summer sessions), or (b) the end of 12 months if the student is not enrolled, whichever is shorter. Incompletes that change to F will count as attempted courses on transcripts. The burden of fulfilling an incomplete grade is the responsibility of the student. The university policy on incomplete grades is located at:

`https://policies.ncsu.edu/regulation/reg-02-50-03/`.

Attendance Policy/Absence Policy/Late Assignments/Make-up Work: You are expected to attend all classes on time. Late assignments and make-up work will only be allowed for excused absences. You should contact me by email or in person before any anticipated excused absence. If you have an unanticipated excused absence (for example, a medical emergency), you should contact me within one week of returning to class.

For complete attendance and excused absence policies, please see:

`https://policies.ncsu.edu/regulation/reg-02-20-03-attendance-regulations/`

For unexcused late homework submissions, a 5% penalty for each day that the homework is late will be applied.

Health and Participation in Class: We are all concerned about your health, as well as the health of all of our students, faculty, and staff at NC State.

- If you test positive for COVID-19, or are told by a healthcare provider that you are presumed positive for the virus, you should not attend our class or any in-person class. Please also follow other university guidelines, including self-reporting (Coronavirus Self Reporting): Self-reporting is not only to help provide support to you, but also to assist in contact tracing for containing the spread of the virus.
- If you feel unwell, even if you have not been knowingly exposed to COVID-19, please do not come to in-person classes or activities.
- are expected to follow all university policies and guidelines for the use of

COVID-19 Related Absences: If you need to miss class because you have been advised that you may have been exposed to COVID-19 or you have a personal or family situation related to COVID-19 that prevents you from attending our sessions, please contact me. Together we will develop a plan to help you keep up with your coursework during any such absences. COVID 19-related absences will be considered excused. You do not need any additional documentation. (But, again, please make sure you contact me.)

Academic Integrity Statement and Academic Dishonesty: Students are required to comply with the university policy on academic integrity/honesty found in the Code of Student Conduct:

`https://policies.ncsu.edu/policy/pol-11-35-01/`

Violations of academic integrity will be handled in accordance with the Student Discipline Procedures (NCSU REG 11.35.02).

Digital Course Components: In this course we will use Zoom and Moodle. Please see the relevant technology requirements in

`https://docs.google.com/document/d/1Bfrka-Y4qm3WouAGOnCm0YBAytykTjQjvEBErBkNDgc/edit`.

If you need access to additional technological support, please contact the Libraries' Technology Lending Service:

`https://www.lib.ncsu.edu/devices`.

Students may be required to disclose personally identifiable information to other students in the course, via electronic tools like email or web-postings, where relevant to the course. Examples include online discussions of class topics and posting of student coursework. All students are expected to respect the privacy of each other by not sharing or using such information outside the course.

Moodle: All reading materials are housed on the course page in Moodle.

Zoom: I will conduct my regular office hours (Wednesday 12–1) via Zoom. You can also make appointments to meet with me over zoom, if these office hours do not work for you.

Diversity, Equity, and Inclusion: Diversity, equity, and inclusion are important to the success of our students at NC State. Every student, every faculty member, and every staff member who comes to NC State enriches us through their varied perspectives, knowledge, and backgrounds. Our classroom is one in which every student is respected and feels heard. In an effort to affirm and respect the identities of transgender students in the classroom and beyond, please contact me if you wish to be referred to using a name and/or pronouns other than those listed in the student directory. I welcome any additional suggestions you have for including the value of diversity, equity, and inclusion in this course.

Accommodations for Disabilities: Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with the Disability Resource Office at Holmes Hall, Suite 304, Campus Box 7509, 919-515-7653. For more information on NC State's policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation (REG02.20.01).

Non-Discrimination Policy: NC State prohibits discrimination, harassment, and retaliation that are based upon a person's race, color, religion, sex (including pregnancy), national origin, age (40 or older), disability, gender identity, genetic information, sexual orientation, or veteran status (individually and collectively). If you feel that you have been the subject of prohibited discrimination, harassment, or retaliation, you should contact the Office for Institutional Equity and Diversity (OIED) at 919-513-0574.

NC State's policies and regulations covering discrimination, harassment, and retaliation may be accessed at `http://policies.ncsu.edu/policy/pol-04-25-05` or `http://oied.ncsu.edu/divweb`.

Health and Well-Being Resources: These are difficult times, and academic and personal stress are natural results. Everyone is encouraged to take care of themselves and their peers. If you need additional support, there are many resources on campus to help you:

- Counseling Center (link)
- Health Center (link)
- NC State CARES Team: As members of the NC State Wolfpack community, we each share a personal responsibility to express concern for one another and to ensure that our campus remains a healthy and safe environment for learning. Occasionally, you may come across a classmate whose personal behavior concerns

or worries you, either for your classmate's well-being, for your well-being or for the well-being of others. When this is the case, I would encourage you to report the behavior to the NC State CARES team: Share a Concern.

- If you or someone you know are experiencing food, housing or financial insecurity, please see the Pack Essentials Program (Pack Essentials).

Community Standards related to COVID-19: We are all responsible for protecting ourselves and our community. Please see the community standards and regarding Personal Safety Requirements Related to COVID-19.

NC State Rules and Regulations: Students are responsible for reviewing the NC State University Policies, Rules, and Regulations (PRRs) which pertain to their course rights and responsibilities, including those referenced both below and above in this syllabus:

- Equal Opportunity and Non-Discrimination Policy Statement with additional references at `https://oied.ncsu.edu/equity/policies/`
- Code of Student Conduct

Important Resources for Students:

- Introduction to Zoom for Students:
  `https://youtu.be/5LbPzzPbYEw`
- Learning with Moodle, a student's guide to using Moodle:
  `https://moodle-projects.wolfware.ncsu.edu/course/view.php?id=226`
- Protect the Pack FAQs:
  `https://www.ncsu.edu/coronavirus/frequently-asked-questions/`
- NC State Protect the Pack Resources for Students:
  `https://www.ncsu.edu/coronavirus/reactivating-campus/resources-for-students/`