MATH/CS 4334.001 (20421/22442) Syllabus
Numerical Analysis
Spring 2021, Tu/Th 4–5:15pm, Remote/Virtual

Instructor: Dr. Minkoff
Dr. Minkoff's Information: Office: FO 2.402B
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Website: *http://www.utdallas.edu/∼sminkoff*
Note that I will maintain a web page for this course linked from my main web page.

Office Hours: Tuesdays 3–3:45 pm or by appointment. Office hours will be held in Blackboard Collaborate via a link in eLearning for the class.

Course Modality and Expectations:

Remote Instructional Mode: Synchronous online learning at the day and time of the class. The instructor delivers the instruction from home or the office. Students complete the course at a distance.
(See: https://covid.utdallas.edu/students-families-info/spring-2021-registration/.)

Course Platform: We will use Blackboard (BB) Collaborate from within eLearning for class lectures. We will also use BB Collaborate for office hours. The course lectures will be set up for the semester before the start of the semester so that each Tu/Th students can log into the class via eLearning and the session will be available for that day for students to join with their laptops. Students who have connectivity issues can also call into the session via the phone number given within BB Collaborate. I will post lecture notes for the coming lecture before the start of class each day, and we will talk through the notes and answer questions in real time. We will also use the Breakout sessions to work problems in small groups. Homework assignments will be posted on my website. However, students will turn the homework in via eLearning. In the "assignments" section for the class you will see an assignment listed that will allow you to upload your scanned homework each week. *Note that each student will upload a single pdf file with their homework assignment each week.* Please do not upload multiple files for each assignment. *The pdf file you upload will be named following the convention "Student name Assignment number.pdf".* For example, when John Smith uploads homework 1 the file will be named "John Smith Assignment 1.pdf". You will be given 2 chances to upload your homework each week in case of unintended error. The assignments will be open for submission 24 hours before they are due. They will be due at the start of class (4pm) on the date they are due (generally Thursdays).

Expectations: My expectation is that students will participate synchronously with the class as they would if they were attending in person. However, if for some reason synchronous participation is not possible, I will post recordings of the lectures and lecture notes in eLearning for all students to access. I always expect students to attend class and to turn up on time. Rarely do students do well in classes which they do not attend, and if you only watch the video recordings you will not be able to participate in the active

learning activities or discussions that occur during the regularly scheduled class time.

Academic Conduct: I take academic dishonesty *very seriously* and will not tolerate it in this class in any form. **Academic misconduct includes willfully cheating on or giving aid during an exam or copying homework assignments (from the web, from each other, or from a solutions manual).** Blatant copying on an exam, homework assignment, or computer assignment will be reported to the university as an academic conduct violation. Further information on the academic conduct policy can be found at http://www.utdallas.edu/deanofstudents/dishonesty/

Asynchronous Learning Guidelines: While I would prefer students to participate in class synchronously, for those who choose to participate asynchronously, I must be notified before you begin asynchronous instruction. Students who participate asynchronously will miss the class discussion and active learning that occurs during the class. If you are participating asynchronously, it is essential that time is put into watching the posted video recordings before you start the homework each week, studying the lecture notes, and completing the homework assignments and quizzes. **In order to receive the participation grade, asynchronous students will be required to do the weekly quizzes on Thursdays.** Quizzes will be available Thursday after class and must be taken by midnight on Thursday each week (except for the week of the midterm). The quizzes will test that you have digested the material from the week's lectures before attempting the homework. Late homework will not be accepted. For further details on asynchronous learning defined by the university see https://covid.utdallas.edu/response/faq/#asynchronous

COVID-19 Guidelines and Resources: The information contained in the following link lists the Universitys COVID-19 resources for students and instructors of record. Please see http://go.utdallas.edu/syllabus-policies.

Class Participation: Regular class participation is expected regardless of course modality. **I will be assessing participation one of two ways. For those students who attend synchronously, your participation grade will consist of (1) attendance at lectures, (2) contributing to the discussion by asking and answering questions and (3) participating in the active learning exercises. Asynchronous students will receive their participation grade by (1) watching the video recordings each week before starting the homework and (2) taking a weekly quiz on Thursdays.** Students who fail to participate in class regularly are inviting scholastic difficulty. A portion of the grade for this course is directly tied to your participation in this class. It also includes engaging in group or other activities during class that solicit your feedback on homework assignments, readings, or materials covered in the lectures. Class participation is documented by faculty. Successful participation is defined as consistently adhering to University requirements, as presented in this syllabus. Failure to comply with these University requirements is a violation of the Student Code of Conduct (https://policy.utdallas.edu/utdsp5003).

Class Recordings: The instructor will record meetings of this course. Recordings will be available to all students registered for this class as they are intended to supplement the classroom experience. Students are expected to follow appropriate University policies and

maintain the security of passwords used to access recorded lectures. Unless the Office of Student AccessAbility has approved the student to record the instruction, students are expressly prohibited from recording any part of this course. Recordings may not be published, reproduced, or shared with those not in the class, or uploaded to other online environments except to implement an approved Office of Student AccessAbility accommodation. If the instructor or a UTD school/department/office plans any other uses for the recordings, consent of the students identifiable in the recordings is required prior to such use unless an exception is allowed by law. Failure to comply with these University requirements is a violation of the Student Code of Conduct (https://policy.utdallas.edu/utdsp5003).

Class Materials: The Instructor will provide class materials that will be made available to all students registered for this class as they are intended to supplement the classroom experience. These materials may be downloaded during the course. However, these materials are for registered students' use only. Classroom materials may not be reproduced or shared with those not in class, or uploaded to other online environments except to implement an approved Office of Student AccessAbility accommodation. Failure to comply with these University requirements is a violation of the Student Code of Conduct (https://policy.utdallas.edu/utdsp5003).

Prerequisite: MATH 2370 or CS 1324 or CS 1325 or CE 1337 or CS 1337 or TE 1337 and MATH 2418 and MATH 2451. Note that we will be using Matlab exclusively in this course. Even if you have not had exposure to Matlab previously, you will have time to master the basics of the language by working on the homework assignments.

Course Description (from the catalog): This course covers solution of linear equations, roots of polynomial equations, interpolation and approximation, numerical differentiation and integration, solution of ordinary differential equations, computer arithmetic, and error analysis.

Student Learning Outcomes: Numerical Analysis is the study of algorithms for solving mathematical problems on computers. Most real world integrals can't be evaluated exactly (i.e., their antiderivatives aren't known). Most real world differential equations have non–constant coefficients or must be solved over irregularly–shaped domains and thus must be solved approximately on a computer. In many situations one is working with measured data in which there is no known function describing the data points. Therefore, one must approximate the function of interest by one which is easy to manipulate and which gives the character of the data in question at least at a specific set of points. In all of these cases the approximation used to solve the mathematical problem leads to an error which one would like to understand in order to make decisions about whether the solution is accurate enough for the given task. Does the error lie within a specified tolerance or bound? Does it grow with increasing time? In this course you will explore the world most scientists and engineers work in daily but which is different from what you have seen in previous math courses because the solutions to these problems are by necessity approximate. *Your goal in this course is to grow into a sophisticated scientist who can recognize when it will be possible to find a closed-form (analytic) solution to a problem and when that is not possible or desirable. If you cannot find an analytic solution, you will be able to choose the best numerical method to apply to solve*

the problem and will be aware that your solution is an approximation with error. You will be able to quantify that error.

Texts — Required: *Numerical Mathematics and Computing*, 7th Edition, by Cheney and Kincaid. Publisher: Brooks/Cole, 2013.
Note: Errata List is located here: http://www.cengage.com/resource_uploads/downloads/1133103715_461688.pdf

The course will cover selected sections from chapters 1–8 of Cheney and Kincaid. Textbooks and some other bookstore materials can be ordered online or purchased at the UT Dallas Bookstore.

Technical Requirements: In addition to a confident level of computer and Internet literacy, certain minimum technical requirements must be met to enable a successful learning experience. Please review the important technical requirements on the Getting Started with eLearning webpage (https://ets.utdallas.edu/elearning/students/current/getting-started).

Course Access and Navigation: This course can be accessed using your UT Dallas NetID account on the eLearning website. Please see the course access and navigation section of the Getting Started with eLearning webpage for more information (https://ets.utdallas.edu/elearning/students/current/getting-started). To become familiar with the eLearning tool, please see the Student eLearning Tutorials webpage https://ets.utdallas.edu/elearning/students/current/tutorials). UT Dallas provides eLearning technical support 24 hours a day, 7 days a week. The eLearning Support Center (https://ets.utdallas.edu/elearning/helpdesk) includes a toll-free telephone number for immediate assistance (1-866-588-3192), email request service, and an online chat service.

Communication: This course utilizes online tools for interaction and communication. Some external communication tools such as regular email and a web conferencing tool may also be used during the semester. For more details, please visit the Student eLearning Tutorials webpage (https://ets.utdallas.edu/elearning/students/current/tutorials) for video demonstrations on eLearning tools. Student emails and discussion board messages will be answered within 3 working days under normal circumstances.

Distance Learning Student Resources: Online students have access to resources including the McDermott Library, Academic Advising, The Office of Student AccessAbility, and many others. Please see the eLearning Current Students webpage (https://ets.utdallas.edu/elearning/students/current) for more information.

Server Unavailability or Other Technical Difficulties: The University is committed to providing a reliable learning management system to all users. However, in the event of any unexpected server outage or any unusual technical difficulty which prevents students from completing a time sensitive assessment activity, the instructor will provide an appropriate accommodation based on the situation. Students should immediately report any problems to the instructor and also contact the online eLearning Help Desk (https://ets.utdallas.edu/elearning/helpdesk). The instructor and the eLearning Help Desk

will work with the student to resolve any issues at the earliest possible time.

Grading Policy:

Paper and Pencil and Computer Homework	30%
Participation (synchronous)/Quizzes (asynchronous)	10%
Midterm Exam	30%
Final Exam	30%
Total	100%

Homework: There will be one homework due every 1–2 weeks on Thursdays (the length of time will depend on the schedule). Homework is due by the START of class on Thursday and will be turned in using eLearning. Homework can be turned in early, but late homework will not be accepted.

Please note that the homework constitutes a substantial portion of your overall grade. In order to learn the concepts and be able to apply them to solving problems on exams, etc., you are strongly encouraged to devote as much time as possible to working the homework problems. It is likely that not all homework problems will be able to be graded, but most of your learning will come from devoting good chunks of time each week to the homework. **Please note that students who do not attempt the MATLAB homework rarely pass the class and miss out on learning one of the skills employers value most!** I encourage you to discuss the homework assignments with other students in the class. However, I expect the homework you submit for grading to be written up by you alone (this includes computer programs which must not be duplicates of programs other students turn in).

Tests: There will be two exams: a midterm and a final exam. Both will be given within eLearning. Students are not allowed to use resources from the internet or to work with other students on the exams. These exams will be closed book/notes. You will be given a two hour time window within which to take your 75 minute midterm and a 4 hour time window to take your 2 hour and 45 minute final exam. If you know ahead of time that you cannot take an exam in the designated time window (for example because you are in a very different time zone or because of family responsibilities), you must contact me by email at least 4 days in advance of the scheduled exam requesting to take the exam at an alternate time. Be prepared to provide appropriate evidence in support of your request. The final exam will be comprehensive although material covered after the midterm will be emphasized.

This course will use Honorlock, an online exam proctoring tool, which will be integrated with the exam system in eLearning and is provided free of charge to students by UT Dallas. To successfully take an exam, you need a web camera, a microphone, a laptop or desktop computer (no tablets/phones, but chromebooks work), the Chrome browser, a reliable internet connection, and your photo ID. As soon as possible, students are strongly encouraged to ensure that their computer has the minimum requirements for Honorlock, including the built-in or external webcam. You will be prompted to install the Honorlock Chrome Extension (which you can remove after you finish the test). You will then access the exam within your eLearning course and go through the authentication process. The web camera will monitor you throughout your test. Please see the Support Information for additional information, and contact your course instructor if you cannot procure the minimum required technology.

We will provide students with the opportunity to do a mock test using Honorlock prior to the first time we use it for assessment.

Email: I am happy to answer questions about the class via email. However, I reserve the right not to respond to email if I feel it would be best for the student to discuss his/her question during my office hours. I will not respond to email which does not include the name of the sender.

Tips for Succeeding in this Class:

1. The textbook is intended to *supplement* in class lectures (and vice versa) so if you attend class but do not read the appropriate section in the book you will miss out on a wealth of good information and on an alternate view of the material. The text is an invaluable resource as it acts as a second teacher and as a reference point when topics are unclear. However, I will not test you on material in the text which I don't also cover in class.

2. Before you attempt the homework you should *read the sections in the book if appropriate, watch the recorded lectures if attending asynchronously, and study your notes.*

3. You will benefit greatly from working with others in the class so long as you use your peers as a way to hash over concepts and not a way to "get the answers". In other words, *start early* and use your fellow-classmates to discuss the best way to approach the problems. Then go off and try to work out the details yourself.

4. **Begin the new homework assignment the same day you turn in the previous assignment!** Do not wait 3–4 days to start the homework as then you will not have enough time to digest the material or understand the point of the problems. When computer assignments are given starting early on the homework is essential. Debugging programs takes time and your grade and learning will suffer if you attempt the computer problems at the last minute. If your code does not give output (i.e., does not run) you will lose at least half the points for that problem.

5. Come to office hours and get help if you are stuck. It is much better to get help early than to wait. I may ask you to show me what you've come up with at the board so you should have at least attempted the homework problems before asking for help.

6. If you have not previously used Matlab you will need to start playing with the software the first week of class. There are good tutorial pages within Matlab.

Comet Creed: This creed was voted on by the UT Dallas student body in 2014. It is a standard that Comets choose to live by and encourage others to do the same:

   "As a Comet, I pledge honesty, integrity, and service in all that I do."

Academic Support Resources: The information contained in the following link lists the Universitys academic support resources for all students. Please go to Academic Support Resources webpage (https://provost.utdallas.edu/syllabus-policies/#academic-support-resources)

for these policies.

UT Dallas Syllabus Policies and Procedures: The information contained in the following link constitutes the Universitys policies and procedures segment of the course syllabus. Please go to UT Dallas Syllabus Policies webpage (https://go.utdallas.edu/syllabus-policies) for these policies.

Important Dates:

Date	Notes
1/19/21	First day of class
1/26/21	Last day to register and last day to add/swap
2/3/21	Last day to drop class without a "W"
3/9/21	Midterm Exam
4/5/21	**Absolute Last day to drop class**
5/8/21	Last day of classes
TBD	Final Exam

The descriptions and timelines contained in this syllabus are subject to change at the discretion of the Professor.

Math/CS 4334, Spring 2021, Tentative Schedule:

Date	Section/Topic
Tu 1/19/21	First Day Handout; §1.0 – Preliminary Remarks
Th 1/21/21	Computer Lab
Tu 1/26/21	§1.2 – Review of Taylor Series
Th 1/28/21	§1.3 – Representation of Numbers in Different Bases
Tu 2/2/21	§1.3 – Floating Point Representation
Th 2/4/21	§1.4 – Loss of Significance
Tu 2/9/21	§3.1 – Bisection Method
Th 2/11/21	§3.2 – Newton's Method
Tu 2/16/21	§3.3 – Secant Method
Th 2/18/21	§4.1 – Polynomial Interpolation
Tu 2/23/21	§4.1 – Polynomial Interpolation
Th 2/25/21	§4.2 – Errors in Polynomial Interpolation
Tu 3/2/21	§4.2 – Errors in Polynomial Interpolation
Th 3/4/21	§5.1 – Trapezoid Rule
Tu 3/9/21	Midterm Exam
Th 3/11/21	§5.3 – An Adaptive Simpson's Scheme
Tu 3/16/21	Spring Break
Th 3/18/21	Spring Break
Tu 3/23/21	§5.4 – Gaussian Quadrature Formulas
Th 3/25/21	§5.4 – Gaussian Quadrature Formulas

Date	Section/Topic
Tu 3/30/21	§2.1 – Naive Gaussian Elimination
Th 4/1/21	§2.3 – Tridiagonal and Banded Systems
Tu 4/6/21	§2.2 – Condition Number and Gaussian Elimination with Scaled Partial Pivoting
Th 4/8/21	§2.2 – Gaussian Elimination with Scaled Partial Pivoting
Tu 4/13/21	§8.1 – LU Factorization
Th 4/15/21	§8.4 – Iterative Solution of Linear Equations
Tu 4/20/21	§8.2 – Singular Value Decomposition (SVD)
Th 4/22/21	§8.2 – Singular Value Decomposition (SVD)
Tu 4/27/21	§7.1 – Taylor Series Methods
Th 4/29/21	§7.2 – Runge-Kutta Methods
Tu 5/4/21	Catch Up Day
Th 5/6/21	Review for Final Exam
TBD	**Final Exam**