MATH/CS 4334.002.19F (87556/87627) Syllabus
Numerical Analysis
Fall 2019, Tu/Th 11:30am – 12:45pm, FN 2.106

Instructors: Dr. Minkoff (UTD) and Dr. Villalobos (UTRGV)
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Note that I will maintain a web page for this course linked from my main web page.

Office Hours: Tuesdays 2:45–3:45 pm or by appointment.

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.

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 1–9 of Cheney and Kincaid.

Grading Policy:

Paper and Pencil Homework	15%
Computer Homework	15%
Exam 1	20%
Exam 2	25%
Final Exam	25%
Total	100%

Statement on IMPACT Course: This course is part of IMPACT: Increasing Mathematics Potential Across Texas. This new initiative, developed in collaboration between the UTD and UTRGV sister campuses and funded by the NSF (grants 1820765 and 1820771), aims to leverage the expertise and resources of both institutions to improve the educational outcomes of upper-level mathematics courses through active learning at both institutions. This course will be taught in a blended format, with lectures attended synchronously by students at both institutions and taught jointly by staff from both institutions.

Homework: There will be one homework due every 1–2 weeks on Thursdays (the length of time will depend on the difficulty of the assignment). Homework is to be turned in at the START of class on Thursday or can be slipped under my office door *prior* to class on Thursday if you must miss class for some reason. *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!** 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: No make-up exams will be given except *possibly* in the case of a serious emergency. In such a case I *must* be notified *in advance*. There will be no exceptions to taking the final exam at the date, time, and place specified by the University. The final exam will be comprehensive although material covered after the midterm will be emphasized.

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.*

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 result in a grade of zero for that work. Further information on the academic conduct policy can be found at http://www.utdallas.edu/deanofstudents/

dishonesty/

UT Dallas Syllabus Policies and Procedures:

The information at http://go.utdallas.edu/syllabus-policies constitutes the University's policy and procedures segment of the course syllabus.
The descriptions and timelines contained in this syllabus are subject to change at the discretion of the Professor.

Class Attendance: I expect students to attend class and to turn up on time. Rarely do students do well in classes which they do not attend, and I will be less likely to give outside assistance to students who regularly miss class. **Further, students arriving late for class disrupt the entire class. Students should also note that I do not allow cell phones, laptops or other electronic devices to be used in class (except tablets for note taking) and will ask that these items be turned off at the start of class.**

Email: I am happy to answer questions about the class via email. However, it is much better for you if we can talk in my office at the board. Answers given over email will be brief and intended merely to answer your direct question rather than to explain concepts. I reserve the right not to respond to email if I feel it would be best for the student to discuss his/her question in person 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 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 many good tutorial pages provided by MathWorks.

Important Dates:

Date	Notes
8/19/19	First day of class
8/26/19	Last day to register and last day to add/swap
9/4/19	Last day to drop class without a "W"
9/24/19	Exam 1
10/24/19	**Absolute Last day to drop class**
10/29/19	Exam 2
12/5/19	Last day of classes
TBD	Final Exam

Math/CS 4334, Spring 2019, Tentative Schedule:

Date	Section/Topic
Tu 8/20/19	First Day Handout; (UTD only) §1.0 – Preliminary Remarks §1.2 – Review of Taylor Series
Th 8/22/19	Computer Lab (UTD only)
Tu 8/27/19	§1.2 – Review of Taylor Series (UTRGV) §1.3 – Representation of Numbers in Different Bases (UTD)
Th 8/29/19	§1.3 – Floating Point Representation (UTD)
Tu 9/3/19	§1.4 – Loss of Significance (UTD)
Th 9/5/19	§3.1 – Bisection Method (UTRGV)
Tu 9/10/19	§3.2 – Newton's Method (UTRGV)
Th 9/12/19	§3.3 – Secant Method (UTRGV)
Tu 9/17/19	§4.1 – Polynomial Interpolation (UTRGV)
Th 9/19/19	§4.1 – Polynomial Interpolation (UTRGV)
Tu 9/24/19	**Exam 1**
Th 9/26/19	§4.2 – Errors in Polynomial Interpolation (UTD)
Tu 10/1/19	§4.2 – Errors in Polynomial Interpolation (UTD)
Th 10/3/19	§5.1 – Trapezoid Rule (UTD)
Tu 10/8/19	§5.3 – An Adaptive Simpson's Scheme (UTRGV)
Th 10/10/19	§5.4 – Gaussian Quadrature Formulas (UTRGV)
Tu 10/15/19	§5.4 – Gaussian Quadrature Formulas (UTRGV)

Date	Section/Topic
Th 10/17/19	§2.1 – Naive Gaussian Elimination (UTRGV)
Tu 10/22/19	§2.3 – Tridiagonal and Banded Systems (UTRGV or UTD)
Th 10/24/19	§2.2 – Gaussian Elimination with Scaled Partial Pivoting (UTD)
Tu 10/29/19	**Exam 2**
Th 10/31/19	§2.2 – Gaussian Elimination with Scaled Partial Pivoting (UTD)
Tu 11/5/19	§8.1 – LU Factorization (UTRGV)
Th 11/7/19	§8.4 – Iterative Solution of Linear Equations (UTD)
Tu 11/12/19	§8.2 – Singular Value Decomposition (SVD) (UTD)
Th 11/14/19	§6.2 – Singular Value Decomposition (SVD) (UTD)
Tu 11/19/19	§7.1 – Taylor Series Methods (UTRGV)
Th 11/21/19	§7.2 – Runge-Kutta Methods (UTRGV)
Tu 11/26/19	§9.1 – Method of Least Squares (UTRGV only, UTD Fall Break)
Th 11/28/19	THANKSGIVING BREAK
Tu 12/3/19	Review for Final Exam (UTRGV only) §9.1 – Method of Least Squares (UTD only)
Th 12/5/19	Review for Final Exam (UTD only)
TBD	**Final Exam**