Syllabus
Math 620, Section 101: Numerical Analysis I
Fall 2010, MW 4:00–5:15 pm, MP 105

Instructor: Dr. Minkoff
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Office Hours: Mondays 2:00–3:00 pm or by appointment.

Prerequisites: For undergraduates: Math 225, Math 251, Math 301, CMSC 201, or instructor approval. 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.

Texts — Required: *Numerical Analysis: Mathematics of Scientific Computing*, 3rd Edition, by Kincaid and Cheney. Publisher: Brooks/Cole, 2002.
Recommended: *Mastering MATLAB*, by Hanselman and Littlefield. Publisher: Prentice Hall, Inc.
Additional Reference: *An Introduction to Numerical Analysis* by Atkinson. Publisher: John Wiley & Sons 1989.

Grades:

Homework	30%
Midterm Exam	35%
Final Exam	35%
Total	100%

Homework and computer assignments: There will be one homework (either paper and pencil, computer assignment or a combination) due every week on Wednesdays. Homework is to be turned in at the START of class on Wednesday or can be slipped under my office door *prior* to class on Wednesday 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. 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 (Monday 12/20/10 from 3:30–5:30 pm in MP 105). The final exam will be comprehensive although material covered after the midterm will be emphasized.

Learning Goals and Course Motivation: 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 antiderivative isn'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 data points underlying a function rather than an explicit functional form, and therefore, one must approximate the function of interest by one which is easy to manipulate and which gives the character of the function 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.

Specifically, in this course you will:

1. Review how to represent numbers in different bases and how to convert between different number systems. Emphasis will be placed on base 2 which is the most important for representation of numbers on computers.

2. You will learn why round–off error is so important for numerical algorithms. All numbers represented on a computer must be stored with a finite number of bits. Hence most numbers cannot be stored exactly on a computer.

3. We will discuss finding roots of functions which is especially important in the study of optimization.

4. We will learn ways to represent a table of data values $(x, f(x))$ if the underlying function which generated the data isn't known a priori. The most common way to describe such data is by fitting a degree n polynomial to the set of $n + 1$ points (e.g., fitting a line to two data points). However, there are many other useful representations of the underlying function.

5. We will learn how to decompose functions into a sum of sines (or exponentials) which is important for signal processing, data compression, image processing, etc. And we will learn an extremely efficient way to use computers for this purpose.

6. Most integrals can't be evaluated analytically and must be approximated on a computer. Moreover, computers can't take limits and hence approximating integrals and derivatives on computers requires dropping the limit idea and taking "small" but not infinitesimal quantities in the approximation. Our goal is to understand how accurate such approximations are – a topic that is especially important in the study of differential equations.

7. Finally we investigate iterative techniques for approximating solutions to ordinary differential equations on computers. The most basic idea is Euler's method which approximates the solution at a point in the domain by a short line segment. Other more sophisticated techniques will be discussed.

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 (computer or paper and pencil). Blatant copying on an exam, homework assignment, or computer assignment will result in a grade of zero for that work.

The university now stipulates that the following be included in all class syllabi:

By enrolling in this course, each student assumes the responsibility of an active participant in UMBC's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping others to commit these acts are all forms of academic dishonesty, and they are wrong. Academic misconduct could result in disciplinary action that may include, but is not limited to, suspension or dismissal.

To read the full Student Academic Conduct Policy, consult the *UMBC Student Handbook*, the *Faculty Handbook*, the *UMBC Integrity webpage* www.umbc.edu/integrity, or the *Graduate School website* www.umbc.edu/gradschool.

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 who consistently turn up more than a few minutes late for class or who regularly miss class may be docked points from their final grade.

Email: I am happy to answer questions about the class via email. However, I will not respond to email which does not include the name of the sender.

Important Dates:

Date	Notes
8/31/10	First day of class
9/14/10	Last day to register
9/14/10	Last day for graduate students to drop class (without "W" on transcript)
10/18/10	Midterm Exam
11/12/10	**Absolute Last day to drop class**
11/25–26/10	Thanksgiving Break
12/13/10	Last day of classes
12/20/10	Final Exam