Syllabus
Math 341, Section 101: Computational Methods
Spring 2010, MW 1–2:15 pm, location TBD

Instructor: Dr. Minkoff
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Office Hours: Mondays 2:30–3:30 pm or by appointment.

Prerequisite: Math 152 (or a comparable course), Math 221, CMSC 201 and knowledge of a high-level programming language such as C, Fortran, or Matlab. 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 Mathematics and Computing*, 6th Edition, by Cheney and Kincaid. Publisher: Brooks/Cole, 2008.
Strongly Recommended: a Matlab reference book such as *Mastering MATLAB*, by Hanselman and Littlefield. Publisher: Prentice Hall, Inc. or *Essentials of MATLAB Programming* by Chapman. Publisher: Thomson.
The course will cover selected sections from chapters 1–12 of Cheney and Kincaid.

Grades:

Paper and Pencil Homework	20%
Computer Homework	20%
Midterm Exam	30%
Final Exam	30%
Total	100%

Homework and computer assignments: There will be one homework (which may include paper and pencil and/or computer work) due every week on Wednesday. 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 (Friday 5/21/10 from 1–3 pm in location TBD). 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 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.

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 (zeros) 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 other useful representations of the underlying function.

5. Most integrals can't be evaluated by hand 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.

6. We will talk about how to solve matrix systems (simultaneous equations) in a systematic manner via Gaussian elimination. We will also talk about the expense of using Gaussian elimination to solve large linear systems and about cheaper ways to accomplish this task.

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 will 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. Also, students should be aware that discussions of class concepts and involved homework questions are best asked in person during office hours. I reserve the right not to answer an email question if I feel the topic would best be discussed in person.

Important Dates:

Date	Notes
1/27/10	First day of class
2/9/10	Last day to register and last day to add course
2/23/10	Last day to drop class (without "W" on transcript)
3/31/10	Midterm Exam
4/14/10	**Absolute Last day to drop class**
5/13/10	Last day of classes
5/21/10	Final Exam