Calculus I - Math 251
Syllabus and guidelines 2009-2010
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Text: *Single Variable Calculus, Early Transcendentals*, Stewart, 6th Edition. We will cover roughly chapters 2, 3 and 4.

Exams: There will be 2 midterms at the end of week 4, and at the end of week 8. There will be a two hour final exam at the time scheduled by the registrar's final exam calendar.

Problem Sets: There will be (mostly) weekly homework assignments, Homework will usually be due on Wednesday. The homework assignments will be over the internet via software called *WeBWorK*. The advantage to this system is you will get instant feedback about whether your answer is correct, and thus will have an opportunity to find your mistake and correct it if you did a problem incorrectly. Some of you have used WebAssign. This program is similar in nature, but I believe it is more reliable and easier to use.

Probably all the problems I'll assign are correctly coded in *WebWork*, but to reduce anxiety about *WebWork* errors, homework scores of 90% and above will be rounded up to 100%.

When doing *WebWork* problems, there is a link "email instructor." Please use that to ask any questions about if you are having trouble doing that problem. Doing this gives me a link to click on that shows me your version of the problem (the problems are individualized) and your most recent attempted answer.

Grades: Each hour exam will count as 20% of your grade, the total homework will count as 25% of your grade, and the final exam will count for 35%.

- It is extremely important to study the relevant part of the text *before* the related lecture. This will make lectures easier to understand and give you a chance to ask questions that come up reading the text.
- Doing the homework seriously is the **most** important thing you can do to succeed in this course. Start early, and do some every day. I encourage you to work together on homework, as long as the work you do is really your own.

  The best way to do the WeBWorK homework is to print out the homework, do the problems, and then enter the numeric and symbolic answers. Each student's problems will be similar but individualized. So the same techniques will work to solve your homework as your friend's but the answers will be different.

- Please do ask questions about the homework, or any other aspect of the course in class. I will always be happy to spend the first few minutes of class dealing with homework questions, or questions from previous lectures, so come prepared!

  In order to ask questions effectively, make notes to yourself as you review lectures (and discover points that are unclear to you), as you study the text (and notice things that you are not sure you understand), and as you work on homework and come to problems you have trouble with.

Approximate Schedule

Week 1	2.1,2.2,2.3,2.5,2.6	Week 6	4.1, 4.3, 4.4.
Week 2	2.7, 2.8, 3.1, 3.2.	Week 7	4.5, 4.7.
Week 3	3.3, 3.4, 3.5.	Week 8	Review, exam 2.
Week 4	3.6, 3.7, exam 1.	Week 9	4.2, 4.8
Weel 5	3.8, 3.9. 3.10.	Week 10	REVIEW.

Note: I have a set of WebWork assignments I've used successfully with this syllabus which others can use as a starting point.

Course Goals: The overall goal is for the students to understand the derivative as the slope of the tangent line and to be able compute derivatives and to apply derivatives. I see the most important applications as

(1) Optimization problems. Both word problems and finding minima and maxima of functions on domains such as closed intervals, open intervals (and noticing when there is no minimum or maximum), etc. This is hard to teach because students are still internalizing the idea of "look at endpoints and critical points" when they need to be also translating the words of word problems into mathematics.

(2) Curve sketching. I think this is harder for students to learn than it used to be because it is so easy to use their calculator. Also, many students with weaker algebra skills find it quite difficult to solve inequalities like $f'(x) < 0$.

    I prefer to let students use their calculators, and choose problems carefully so that the students can't use the calculators as a crutch. For example, on exams, I ask them to sketch graphs of functions where the interesting parts of the graph are far enough away from zero so that they have to work so hard to notice what is going on with their calculator that most of the students who are dependent on their calculators for sketching curves will get it wrong. Or, I don't give them a formula for the function, just some information about the derivative (and maybe the second derivative) and ask them to sketch the graph from that. Of course you need to have given them homework questions like this as well if you are going to give them such questions on the exam.

Less major goals that are still worthwhile:

(1) Limits. I'd like them to understand the basic idea of limits, though I don't expect them to learn ϵ-δ proofs. (If Newton could revolutionize physics with only an intuitive understanding of limits, then such an intuitive understanding might be enough for Math 251). This is a slightly contentious point and not everyone agrees with me. The majority of students in Math 251 are not math majors, but there is a significant minority who are. The math majors probably *should* see the ϵ-δ definition, but I don't think it is worth it given how many students aren't math majors.

(2) Improper limits. This is critical to curve sketching. Limits as $x \to \infty$ and analyzing whether undefined limits go to ∞ or $-\infty$ or neither.

(3) Implicit differentiation and tangent lines. Maybe not so vital for anything in the course. Nice for the minority of students who will take multivariable calculus later.

(4) Linear approximation. Also hard to justify as really important in the course, though lots of scientists use linear approximation all the time to replace complicated functions with simpler ones. But it is hard to make good examples that convince the students this is worthwhile. So I use this mostly as an illustration of tangent lines, and I don't make it important.

(5) L'Hopital's rule. Often useful when taking limits to sketch graphs. They need the ∞/∞ form too.

(6) Newton's method. I think this is really fun, and I think it is useful for students to understand the general idea that lots of equations can't be solved explicitly so that techniques for approximating solutions are very important.

<u>Potential Problems:</u>

(1) As I said, a main goal is learning to do optimization problems. This comes late in the course. In my syllabus I push it early enough so that I can ask optimization question on the second midterm, as well as the final. If you let it slide to the last week, the students won't have time to learn this properly.

(2) Algebra background. A lot of the students in this course will have insufficient algebra background. Many of them can catch up, but they'll have a real slog, and will have to spend way more time on homework than the 8-9 hours per week that I expect from everyone.

    They have trouble with things like factoring polyonmials and simplifying rational expressions. This makes it hard for them to do things like analyze whether derivatives (and second derivatives) are positive and negative.