M251: **Calculus I**
Syllabus 2017-2018
Course coordinator: Dan Dugger

Instructor: Put your name and contact information and office hours in.

Text: *Calculus, Concepts and Contexts, 4th edition*, Stewart.

We will cover roughly Chapter 2, 3 and 4. Students should read Chapter 1 on their own and it should be review for them.

Chapter 2 is on limits and derivatives. Limits should not be overemphasized. Their importance is to understanding derivatives and to understanding asymptotic behavior of functions.

Chapter 3 is on techniques of differentiation with a couple later sections devoted to application.

Chapter 4 is on applications of derivatives and should be the heart of the course, with the most important applications being optimization (Chapter 4.6). Because of this, it is essential to cover Chapter 4.6 by week 9 at the very latest (new material covered in the last week of class is very rarely retained). Note also that in Fall week 9 is short.

Note: I have tried an approach to this course that gets to Section 4.6 in Week 4 or 5. This required some ingenuity but worked very well. See Note (1) under "Approximate Schedule" below for more information.

Prerequisite: C- or better in Math 112 or satisfactory placement exam score. Note that we have no enforcement mechanism in place for this prerequisite, so that there is no guarantee that the students enrolled in your class have met the prerequisite.

Exams: I've written a schedule for two midterms and a final. One midterm is really not a good idea, since the students in this course need more feedback rather than less.

Bear in mind that there are calculators available that can do symbolic limits and differentiation and can find extrema of functions. If you allow calculators on the midterms, then you will need to write problems that don't give students who possess such calculators an unfair advantage.

Synchronization: **This is important!** Many aspects of students' experiences in MA251 will of course vary from section to section. It is important, though, that the variation not be too much. If a student is struggling in one section and he sees that the problems his instructor is giving are much more difficult than the problems another instructor is giving, that feels horrible. And it can put the math department in a very awkward and untenable position. It is very important that students in different sections of 251 learn basically the same material, and are assesssed in basically

the same ways. A little variation among instructors is fine and healthy, but it should be kept from veering too far.

For a few years we experimented with a system where we used a common final exam and a common grading system. Currently we are using a much more individualized system, where instructors have the freedom of writing their own finals and making out their own grades. However, with great power comes great responsibility; it is important that the assessments in each section have a similar "look and feel". To accomplish this, during the first week of classes the course coordinator will provide instructors with an exam bank consisting of final exams from the past few years. We ask that you arrange your exams (midterms and final) so that 85% of the points on each exam have a similar "look and feel" to the questions on these model exams.

This "look and feel" issue is of course open to interpretation, and that is intentional. It does not mean that you have to copy the questions from the model exams and change the numbers. It does not mean that you cannot have exam questions on topics that are not covered by the models. It *does* mean that if your questions were swapped into one of the model exams, most people would rate the two exams as being very similar in tone and content.

Here are some extreme situations that would violate the "look and feel" test:

- Your final exam has 5 questions worth 5 points each.
- 50% of the problems on your final exam involve inverse trig or hyperbolic trig functions.
- 50% of your exam is true/false or multiple choice.

We ask that after your final exam is written you send a copy to the Director of Undergraduate Studies (Robert Lipshitz). He will send out an email near the end of the term reminding you of this. You do not have to wait for "approval" before administering your exam, but this way we have a common record of what is happening in the different sections. If your exam differs markedly from the desired "look and feel", expect a conversation about that.

Workload: There will be homework due every week, as well as reading and class attendance. Some years I have broken up the homework assignment and had the problems due twice a week, say on Tuesdays and Fridays—this keeps students from putting everything off until the last minute and not practicing the skills that are being used in lecture.

An average well-prepared student should expect to spend about 12 hours per week on this class, but there will be a lot of variation depending on background and ability.

Course Learning Goals: The students in Math 251 are mostly science majors of some kind. They need to understand how to model problems that can be solved with calculus and then use calculus to solve those problems. (Only a very small percentage of students in Math 251 are math majors, and thus mathematical proof is not a reasonable emphasis for the course.)

A successful student in this course **should be able to model and solve a wide class of optimization problems that are accessible to differential calculus.** Much of the other material covered in this course is necessary for that objective. So subgoals include:

(1) Learning how to differentiate - this is necessary if you wish to use calculus to solve optimization problems.

(2) Learning how to sketch graphs of functions - this is necessary to help identify where to search for local/global extrema when trying to optimize.

(3) Understanding some basic facts about limits - this is needed for two reasons: to incorporate an understanding of the geometric interpretation of the derivative as the slope of the tangent line of a graph, and also to aid in sketching graphs of functions exhibiting asymptotic or discontinuous behavior.

It is not important for students to understand the ϵ-δ definition of limit in this course (which is not to say that an instructor cannot spend a little time on it if he or she sees fit).

(4) Students should be able to solve related rates problems. These are less central than optimization, but can be introduced early as a source for problems that require students to practice modeling.

(5) Students should be able to find the linear approximation to a function at a specific value of the variable, graph the linear approximation and the function on the same pair of axes, and use the linear approximation to find approximations to values of the function near the point at which the approximation is taken.

Learning Environment: The University of Oregon strives for inclusive learning environments. Please notify me if the instruction or design of this course results in disability-related barriers to your participation. You are also encouraged to contact the Accessible Education Center in 164 Oregon Hall at 541-346-1155 or uoaec@uoregon.edu.

Academic Conduct: The code of student conduct and community standards is at conduct.uoregon.edu. In this course, it is appropriate to help each other on homework as long as the work you are submitting is your own and you understand it. It is not appropriate to help each other on exams, to look at other students exams, or to bring unauthorized material to exams.

APPROXIMATE SCHEDULE

This is only a suggested schedule, and you should feel free to alter as you see fit. Please read note (1) below for another possibility to consider.

Week 1	2.1-2.4	Week 6	4.1, 4.2.
Week 2	2.5-2.7	Week 7	4.2, 4.3.
Week 3	2.8-3.2	Week 8	4.5, 4.6 (exam 2).
Week 4	3.3-3.5 (exam 1).	Week 9	4.6
Week 5	3.7-3.9	Week 10	4.7(optional), review.

Notes:

(1) Students have a difficult time with the modelling problems (what used to be called word problems). The last time I taught MA251 I tried to help with this by moving Section 4.6 to much earlier in the course. I did some part of this section right after Section 3.4. At this point in the course students do not know how to differentiate everything, but they know enough to do many of the optimization problems. On a pedagogical level this move is a bit dicey, as students do **not** know enough to check that their critical point is really a min or max—but in many of the problems there is only one critical point anyway, and so this issue can be sidestepped with some care.

Moving 4.6 to earlier in the course allowed me to subsequently give optimization homework problems every week for the rest of the quarter, which was very nice and allowed students to get more practice than they typically would. I recommend this approach, and would do it again, but because of the problems inherent in teaching out of order from the textbook I have not taken that route on the schedule I gave above.

(2) For me the first week is the most difficult part of the course to get through. The limit material is not very inspiring, and it treads on for days. It is important to keep this material under control and not spend too much time on it: it is not needed heavily in the rest of the course, but the students do need to understand the basic ideas.

It would be nicer to get to derivatives in week 1. It might be worth finding a schedule that gets to derivatives earlier and then comes back to do more stuff about limits as needed.

(3) This schedule does not include a section explicitly on the derivatives of inverse functions. The specific examples that arise (logarithm and inverse trig functions) can be handled by using the chain rule together with the fact that $(f \circ f^{-1})(x) = x$. Of course the general rule can also be handled that way if you are motivated to teach the general rule.

(4) Section 4.5 is L'Hospital's rule. If you are short on time (and this is an agressive schedule so you might be) you can put off Section 4.5 until Week 10.

(5) I usually use WeBWorK when teaching this course. If you are not going to do that, you can consult Chris Sinclair's syllabus from 2012-2013 to see suggested homework assignments from the text itself.

The current set of default assignments (setWeek1 to setWeek10) cover as follows:

Week1. Sections 2.1-2.5 about limits.
Week2. Section 2.6: The difference quotient, definition of derivative, secant lines, average and instantaneous velocity.
Week3. Section 2.7-3.1: Derivatives using the power rule, exponential functions. Also tangent lines and the derivative as a functions. Velocity and acceleration. Exponential growth (this last topic involves no calculus, but is a convenient way to remind them how to model with exponential functions).
Week4. Sections 3.2, 3.3. Product rule, quotient rule, trig functions.
Week5. Sections 3.4, 3.5: Chain rule, implicit differentiation.
Week6. Sections 3.4, 3.5, 3.7, 3.9, 4.1: Chain rule, related rates, linear approximation, implicit differentiation.
Week7. Sections 4.2, 4.3: Concavity, curve sketching, function optimization.
Week8. Sections 4.3, 4.5, 4.6: l'Hospital, improper limits, optimizations problems requiring modeling, curve sketching.
Week9. Section 4.6, 4.7: Optimization, Newton's method.
Week10. Review.

The intention is that assignment WeekN be given after week N of term, though depending on precisely how fast material is covered, you may want to alter that. You may also want to alter the assignments or create your own.

If you wish to give a short assignment early in the first week, you could use the CandC-4E-1-1 WeBWorK assignment which reviews a few relevant Math 111 topics. Or you may want to break up the Week1 assignment.

(6) Newton's method (Section 4.7) is an optional topic. It is included in the Web-Work assignments for historical reasons, but you should feel free to eliminate those problems.

Students need to be taught a reasonable approach to using WebWork. My syllabus usually includes something like the following:

Showing work:

When working on your assignment you should have scratch paper available and neatly write out your thought process in solving the problem. While WebWork does not grade you on this process, writing it out carefully will train you in the skills you need. It will help you track down mistakes, and it will help *us* track down mistakes when you ask for our help. If you ask us a question about a homework problem in office hours, the first thing we will probably do is ask you to show us your work.

Also, remember that on quizzes and exams showing your work will sometimes be required. It is important to practice this each week while doing your homework assignments.

Logging in to Webwork: First go to the main login page at

http://webwork2.uoregon.edu/webwork2

Select the "Math251-13891" section. Your username is your DuckID: for instance, if your uoregon email address is johndoe@uoregon.edu, your DuckID is "johndoe" (without the quotation marks). Your password is the same as your UO email password.

Getting help:

If you have a question about a homework problem, one excellent resource is the "Email instructor" button at the bottom of the WebWork screen. Clicking on that and typing a short message about what you've tried on the problem will help me diagnose the issue you're having.

What you should NOT do: Do not send an email simply saying "What am I doing wrong on this problem" or "I can't seem to get the right answer on this one." On most homework problems it is impossible to figure out what you are doing wrong if I only see your answer (which is all WebWork shows me).

What you SHOULD do: If WebWork tells you your answer is wrong, first go back over your work and see if you can find the mistakes yourself. If you can't, feel free to email me: but include a description of how you solved the problem as well as any work you did for intermediate steps. The more information you give, the more likely it is you will get a prompt and helpful reply.