

Calculus II - Math 252.
Syllabus 2016-2017
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 5-6 and parts of Chapter 7 (*not* section 6.8 which will be covered in Math 253).

Chapter 5 covers the notion of integral, the Fundamental Theorem of Calculus (which allows you to use your knowledge of derivatives to evaluate some integrals) and various techniques for calculating integrals.

Chapter 6 covers various applications of the integral to things like areas, volumes and lengths of curves, and to physics, engineering, biology and economics.

Chapter 7 covers some elementary ordinary differential equations.

Warning: If you have never used Wolfram Alpha, do the following as soon as possible: go to <http://www.wolframalpha.com>, type

“integrate from 0 to pi $x^2 \sin^3(x)$ ”

and see what comes back. In light of the ability of modern technology to do symbolic integration, it is worthwhile to spend some time thinking about how that should impact the amount of time we spend on teaching integration techniques. I am not suggesting an answer, just that you think about it before (or while) teaching the course. It is also important to keep in mind during the course that every student knows about Wolfram Alpha and will happily use it for homework problems, no matter how many times you tell them that they can't use it on the exams.

It would be nice to figure out how to incorporate modern technology into this course in a reasonable way. However, I do not know anyone who has taken steps in this direction. If you end up developing materials for this, please let me know!

Exams: I've written a schedule for two midterms and a final. One midterm might be acceptable, but two is better since the students in this course need more feedback rather than less.

Bear in mind that there are calculators available that can do symbolic differentiation and integration and even solve some differential equations. If you allow calculators on exams, then you will need to write problems that don't give students who possess such calculators an unfair advantage.

You should put the time of your final exam, from the registrar's website based on your class starting time, on the syllabus.

Prerequisite: C- or better in Math 251.

Workload: There will be homework due every week, as well as reading and class attendance. 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 252 are mostly science majors of some kind, leaning more to the life sciences. 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 252 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 problems that can be answered by calculating an appropriate integral. This is the focus of Chapter 6.** In particular, there is a certain skill that I don't have good words for but which is basically "understanding how to write down an integral from a situation in which something to be calculated can be broken up into slices/regions/pieces on which some feature is constant." The real point of all of the applications in Chapter 6 is in developing this skill.

Much of the other material covered in MA252 is necessary for the above objective. So subgoals include:

- (1) Learning to calculate and (roughly) estimate as appropriate the value of a definite integral by examining the graph of the integrand using the definition of the integral as a (signed) area.
- (2) Being able to state and apply the Fundamental Theorem of Calculus.
- (3) Learning how to integrate symbolically (using the Fundamental Theorem of Calculus), including integration by parts and substitution. Note that there is a tension: one could spend the entire term becoming a crack symbolic integrator and do no applications. That isn't appropriate, but at the same time one must master the basic techniques of symbolic integration.
- (4) Understanding heuristically how to think about the integral as being a limit of Riemann sums. This is often needed in applications in the process of recognizing a question as being one that can be answered by integrating.

It is not important for students to understand the formalized definition of an integral as the supremum of the lower sums/infimum of upper sums (or whatever your favorite formalization is) in this course.

A secondary goal is to learn some basic applications that involve solving simple ordinary differential equations. Students who need differential equations for their major will take Math 256, but even students who don't need that course should understand what a differential equation *is*. And of course the only way to do that is to see at least a few types of examples.

- (1) Students should be able to set up and solve basic separable differential equations (Chapter 7.3), in particular the ones that model exponential growth and decay (Chapter 7.4).

- (2) [Optional] Students should be able to set up and solve population growth problems using the logistic equation (Chapter 7.5).

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

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|--------|---------------------|---------|----------------------------------|
| Week 1 | 4.8, 5.1-5.2 | Week 6 | 6.4-6.5 (6.4 optional) |
| Week 2 | 5.3-5.5 | Week 7 | 6.6-6.7 (6.7 optional). |
| Week 3 | 5.6-5.7 | Week 8 | 7.1-7.2 (7.2 optional) (exam 2). |
| Week 4 | 5.8, 5.10 (exam 1). | Week 9 | 7.3-7.4 (7.5 optional) |
| Week 5 | 6.1-6.3 | Week 10 | Review, catch up. |

Notes:

- (1) You can see that I cover sections 5.1-5.6 rather fast, possibly too fast. One could spend essentially forever covering the material introduced in 5.7. This is a bad idea since one never gets to applications. The consequence of this is that students will not be masters of symbolic differentiation before you start covering applications, but that is OK - they will have to continue to work on integration techniques as they learn applications.
- (2) It is not necessary to cover computer algebra systems from 5.8 (though you may). It is necessary to talk about using integral tables, though that can be a single lecture.
- (3) I've skipped Section 5.9. That would be good material to cover, but it isn't actually useful in applications unless you and the students are using software that does these sorts of calculations (or unless you make them write such software). You can certainly choose to cover this if you have software available to the students that makes this worthwhile. It is very nice for students to know about since in real life one often needs to do approximate integration.
- (4) The heart of the course is Chapter 6. Students have a very hard time with Sections 6.2-6.3 and 6.6-6.7. No matter how many examples you do in class, it is not enough. When I last taught MA252 I ended up spending an enormous amount of time on 6.2, 6.3, and 6.6 (maybe almost three weeks just on these sections) and ended up skipping both 6.4 and 6.7. And I was still about a

week behind what is in the above schedule! Be aware that this is the part of the course where you are most likely to get behind.

- (5) Chapter 7 is written in sort of weird way. For students, it is very nice to be able to learn to solve separable differential equations: the technique is fairly easy, the easiness is sort of a relief after the struggles of Chapter 6, and it feels like you are really doing something. So in this part of the course the goal is really to do the basic theory from 7.3 and the applications from 7.4 and (if possible) 7.5. Section 7.2 is nice, and you might want to cover some of it if you have the time, but it is a bit of a distraction. Unfortunately, the way the book is written has the 7.2 material intermixed into some of 7.3, and very intermixed into 7.5. I make a compromise by simply introducing what I need from 7.2 in lecture as needed and skipping those parts of 7.5. But one has to keep this in mind when assigning homework from 7.5.

Of course another option, if there is time, is to cover 7.2.

- (6) Section 6.8 is not included for lack of time, however this is sort of tragic. If you magically have time, consider doing some of 6.8.
- (7) I usually use WeBWorK when teaching this course. That is not a requirement. As always, if you use the default WeBWorK homework sets (or any other WeBWorK problems) do them before you give the lectures on the relevant material so you know what the students will be expected to be able to do.

The current set of default assignments (setWeek1 to setWeek9) cover as follows:

- Week1. Sections 4.8, 5.1-5.2: Anti-derivatives and applications, integral as area, midpoint rule, etc. (31 problems)
- Week2. Section 5.3-5.4: The Fundamental Theorem of Calculus (both parts). A few very easy substitutions. (32 problems)
- Week3. Section 5.5, 5.6: Substitution, integration by parts. (33 problems)
- Week4. Sections 5.5-5.6, 5.10: More substitution, integration by parts and some improper integrals. (21 problems)
- Week5. Section 5.7: Trig manipulation and substitution integrals. (19 problems)
- Week6. Section 6.1-6.3: Areas, volumes. (28 problems)
- Week7. Section 6.5-6.6: Force, work, average value plus a few problems on hydrostatic pressure, centers of mass, centroids. (26 problems)
- Week8. Sections 7.1, 7.2: Introduction to differential equations, direction fields and Euler's method. (28 problems)
- Week9. Section 7.4-7.5: Modeling exponential growth and decay and the logistic equation. (12 problems)

Of course you should expect to make adjustments to homework sets depending on how close you are to the given schedule.

Also, there are some other problem sets not on this list that you may assign all or part of, depending on exactly what you cover. There are three Simpson's Rule problems in the set SimpRul. There are two economics applications in

EconApp. There are some center of mass and centroid problems (a few of which have been included in Week7) in CentMass. There are some hydrostatics problems (a few of which made it into Week7) in HydrPres. There are a bunch of separable differential equations (if you cover 7.3) in SepDEQ. Finally, there are some partial fraction problems (which I don't recommend assigning) in PartFrac.

It can be useful to be proactive in teaching students how to “behave” with 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.