

MATH 1271, FALL 2005
CALCULUS I: LECTURE SECTIONS 60, 70

Lecturer: Professor Al Marden, am@math.umn.edu

Office hours: MW 1:45-2:15, 4:30-4:45, VH 326, 625-5879(voicemail)

Teaching Assistants: (61, 63: Alex Yuffa, yuffa001@math), (62, 64: Fanbin Bu, buxxx001@math), (71, 75: Jun Luo, jluo@math), (72, 74: Chung Luo, luox039@math) ■

Text: Stewart, Early Transcendentals, 5th edition, Chapters 2-6

Quick overview of Calculus I. The big ideas of calculus come this semester: differentiation and integration. These are concepts fundamental not only for the development of mathematics but also for the development of modern science and technology. The content of the course has not changed much in the last 50 years, but the nature of application has changed dramatically because of the power of modern computers: mathematical modeling of natural phenomena has become ubiquitous. For this, understanding of the meaning of “derivative” and “integral” is essential.

Here are the main topics we will cover this semester.

- (1) The derivative $f'(a)$ at $x = a$ as limit of the difference ratio $\frac{f(a+h)-f(a)}{h}$ as $h \rightarrow 0, h \neq 0$.
- (2) Interpretation of derivative as slope of tangent line and instantaneous rate of change.
- (3) Rules for finding derivatives of more complicated functions once derivatives of simpler ones are known, namely

$$(f \pm g)' = f' \pm g', \quad (fg)' = f'g + fg', \quad (f/g)' = (gf' - fg')/g^2, \quad (f \circ g)'(x) = f'(g(x))g'(x). \blacksquare$$

- (4) Using these rules, and starting just with the constants, $f(x) = x$, trig functions, and exponentials, we will find formulas for the derivatives of all functions that can be built up from these simple ones by the operations:

$$f(x) \pm g(x), \quad f(x)g(x), \quad f(x)/g(x), \quad (f \circ g)(x) = f(g(x)), \quad f^{-1}(x).$$

- (5) Finding derivatives by implicit differentiation of equations.
- (6) How to use info about derivatives to solve max/min problems and to qualitatively analyze graphs of functions.
- (7) The integral as a summation process.
- (8) Interpretation of limits of approximating sums, as areas, volumes of revolution, average values.
- (9) Functions defined by integrals; how to compute the values of such functions; derivatives of such functions.
- (10) The easy way to integrate functions recognizable as derivatives of familiar functions.
- (11) Manipulating integrals to change their appearance in hopes they will then be easier to integrate.

In modern science, integrals appear all over the place. (The Institute of Technology pretty much in its entirety could be regarded as an applied math department.) But integrals can rarely be evaluated by hand. This is why we have to learn to regard an integral as the limit of an approximation process, not just as something evaluated by a formula.

Prerequisites. It is *crucial* that you have a good working knowledge of high school math including facility with basic algebraic manipulations, knowledge of analytic geometry of straight lines, trig functions, and exponential functions. Do you know how to simplify $\frac{3}{4} + \frac{5}{7}$, $(3^{\frac{1}{2}})^{\frac{10}{7}}$, and $3^{\frac{3}{8}}3^{\frac{5}{8}}$? How about $\sin^2 \theta + \cos^2 \theta$ and $\tan^2 \theta - \sec^2 \theta$? Do you know how to find the solutions of $x^2 - x - 2 = 0$? If you were “good at math” in high school you should not have trouble passing the course, if you do the necessary work. If you were not “up to speed” in high school math, you will have to work extra hard to pass the course.

Many of you have had some calculus in high school. If so, you may find some differences in content and differences in emphasis, especially more emphasis on understanding the concepts themselves. Yet ours is not a “theoretical” course. Nor is it a course that teaches applications to other subjects. Our philosophy is that if you have a solid grounding in calculus, then when you apply calculus in your courses in biology, chemistry, econ, engineering, physics, . . . , you can concentrate on the subject at hand and not have to worry about the math itself.

Your TA. Your TA is your most valuable resource. He or she is a hard working math grad student who is taking advanced courses and seminars, perhaps doing research for a Ph.D. thesis. Part of the training is to work with students to help them learn calculus. Help them to help you! Ask questions when something in the course is giving you trouble. The job of the lecturer is to give the “big picture” and to work sample problems. The job of your TA is to go over the homework problems and to try to clear up difficulties and misunderstandings. 10% of your grade will be based on your participation in the activities of your section. It will be your TA who grades your quizzes and midterm exams (possibly with other TAs) and assigns your final grade.

Homework The key to passing the course is the practice you get by doing the homework. We learn math by doing it! This means working out each problem yourself, since only YOU can put the new math inside your head. Either you can do the problem or you can't. In the latter case look at the book or your lecture notes; in most cases a similar problem is already worked out. If you still have a problem with the problem, consult a classmate, your instructor, your TA, or go to the help room. The sooner you deal with your problem the better as we quickly move from one topic to the next.

Calculators. A calculator or computer is not needed in the course, although you may have more fun if you have one and want to experiment. Simplification is never required (well, I don't want you to interpret this in the extreme!) In fact heavy reliance on a calculator or computer will prevent you from getting hands-on

experience working with standard functions or solving simple equations—valuable skills to possess.

No calculators, computers, or cell phones will be allowed on the midterm or final exams. Nor will heavy arithmetic or algebraic simplification be required. As some point out, the most powerful general purpose supercomputer is the one inside your head. There will be no exam problems that one cannot easily manage.

Exams: There will be three 50 minute midterm exams, and a 3 hour final common to all students currently taking Calculus I. Most exam problems will be similar to or even the same as homework problems.

If you miss one midterm exam with a good excuse (in advance if possible) given to your TA, your final exam will be given additional weight instead.

Grading: The final will count for 45% and the 3 midterm exams together for 45%. The borderline 10% will be assigned by your TA based on your class participation, and graded quizzes or homework. Typically the distribution of the final grades is approximately 15% A, 25% B, 35% C, and 25% D and F.

We very rarely give the final grade of “incomplete”. To get one, *you must have completed satisfactorily all but a small fraction of course work* and have a very compelling, well documented excuse. If circumstances result in your falling behind, to avoid a low or failing grade you should seriously consider dropping the course and retaking it later.

YOU PAID ABOUT \$1000 TO TAKE MATH 1271. MAKE IT COUNT!

Lecture Schedule. (Not everything in the listed sections will be covered.)

7 Sept and 9 Sept: §§1.3, 2.1, 2.2

12 Sept to 16 Sept: §§2.3, 2.4, 2.5

19 Sept to 23 Sept: §§2.6, 2.7, 2.8, 2.9

26 Sept to 30 Sept: Review on Mon, §§3.1, 3.2; **MIDTERM I TUESDAY**

3 Oct to 7 Oct: §§3.4, 3.5

10 Oct to 14 Oct: §§3.6, 3.7, 3.8

17 Oct to 21 Oct: §§3.10, 3.11, 4.1, 4.2

24 Oct to 28 Oct: Review on Mon. §§4.3, 4.4; **MIDTERM II TUESDAY**

31 Oct to 4 Nov: §§4.5, 4.7, 4.9

7 Nov to 11 Nov: §§4.10, 5.1, 5.2

14 Nov to 18 Nov: §§5.3, 5.4, 5.5

21 Nov and 23 Nov: Mon. Review, Wed. Prize videos; **MIDTERM III TUESDAY, THANKSG.**

28 Nov to 2 Dec: §§5.6, 6.1, 6.2

5 Dec to 9 Dec: §§6.3, 6.5, Review

12 Dec and 14 Dec: Review

The midterm exam days:

TUESDAY, Sept. 27

TUESDAY, Oct. 25

TUESDAY, Nov. 22

FINAL EXAM Thursday, December 15, 1:30 to 4:30

Assigned homework problems:

Section	Page	Problems
1.3	45	1, 2, 3, 5, 6
2.1	91	5, 8
2.2	102	6, 9, 10, 13, 23, 27
2.3	111	odd 11-27, 35, 36, 46
2.4	122	3, 4, 5
2.5	133	3, 4, 5, 6, 7, 37, 38, 43, 47, 48, 63
2.6	146	3, odd 15-31, 51, 61a
2.7	155	7, 8, 9, 15, 17, 27
2.8	163	2, 4, 7, odd 13-23, 27, 35
2.9	173	4, 23, 26, 45
3.1	191	odd 3-27, 40, 45, 50
3.2	197	odd 1-25, 35, 37, 41
3.4	216	odd 1-23, odd 35-39
3.5	224	odd 7-45, 53
3.6	233	odd 1-27, 36, 37, 66, odd 41-49
3.7	240	1, odd 23-33
3.8	249	odd 3-23, odd 35-45, 48
3.10	260	odd 1-11, 12
3.11	267	odd 31-39
4.1	285	3, 5, odd 31-53, 58
4.2	295	1, 3, 5, 11, 14, 16 17, 18 31, 33
4.3	304	odd 11-25, odd 31-45, 67a,b, 69
4.4	313	odd 5-61
4.5	323	odd 1-17, 31, 43, 45
4.7	326	3, 5, 9, 11, 15, 17, 20, 34
4.9	351	1, 3,(for the next problems you need a calculator) 5, 11
4.10	358	odd 1-45, 49
5.1	378	1, 3, 11, 15, 17, 20
5.2	390	1, 11(Riemann sum only), 17, 19, 29, 34, 35, 37, 38, 47, 49, 61,
5.3	402	odd 3-39, 49, 51, 53, 61
5.4	411	odd 1-11, odd 17-33, 45
5.5	420	odd 1-33, 49-57, 74, 79
5.6	429	3, 4
6.1	442	odd 1-27, 44
6.2	452	odd 1-17, 35, 41, 43, 52, 63b
6.3	458	odd 3-15, 21, 23, 29, 30, 37
6.5	467	odd 1-7, 13, 17
Ch. 2	176-7	odd 1-13, 1-19 Review for final
Ch. 3	270-1	odd 1-9, 1-33 Review for final
Ch. 4	361-2	odd 1-15, 1-15, 19-27 Review for final
Ch. 5	430-1	odd 1-9, 3,4,8, odd 9-31,43-47 Review for final
Ch. 6	468	1,3,7,8,9,13, 19, 21, 30 Review for final