MATH 125 FALL 2013

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Office Hours: MW 2:15 – 3:15, Tu 1:15 – 3:30, and by appointment.

Class Meetings: 1:00 – 1:50 MWF in SOS B44 and TTh in GFS 201 at 8, 9, or 10 AM.

Text: *Essential Calculus* 2nd ed., by J. Stewart. We will cover most of Chapters 1 – 4 and half of Chapter 5.

Grading: Regular homework assignments, fairly frequent and short quizzes in the discussion sections, and (likely) two computer assignments will comprise 10% of the course grade. Each of two midterms (on Friday Oct. 4 and Wednesday Nov. 6) and the final exam (***Wednesday Dec. 18*** from ***8:00 – 10:00 AM***) will comprise 30% of the course grade. NOTE: the final exam time is an "Exception" on the exam schedule, and no student make take a final exam early. If you have any conflicts, let me know soon. The letter grade on the final exam may replace half the grade on one midterm. *There will be no make-ups of quizzes.*

Prerequisite: Math 108. You should be familiar with and review: basic algebra (e.g. exponents, factoring); absolute value as distance; finding equations of straight lines and of circles; functions, compositions of functions, graphing functions (by hand!!), and the trigonometric functions. Review §1.1 and §1.2 of the text.

Material of the Course / Other Goals.

The notions of limits and continuity take about three weeks of the course; the derivative and its applications take about five to six more weeks to cover. The theory of the integral takes about three weeks and the last couple of weeks look at the logarithmic and exponential functions and their derivatives There will likely be a bit of time to discuss some differential equations. Calculus is very useful for dealing with many problems modeled with continuous functions. The primary purpose of the course is to explicate this material so that you learn the concepts and applications of them. Another important goal is to develop the habit of thinking carefully and logically, being aware of hypotheses, and expecting justification of statements.

General Comments / Expectations

The approach here is likely to be a bit different from that in other math courses you have had. You have probably been taught mathematics as a collection of procedures for solving problems. Although a significant part of this course involves solving problems, it is important here to understand the material presented: the definitions of terms and the results stated and derived. Understanding the mathematical content has its benefits: it makes new results and procedures easier to remember and use, it justifies proper approaches and procedures to attack problems, and it enables one to deal better with unfamiliar problems. Ideas stay with us much longer than formulas, most of which can be reconstructed from the underlying ideas when needed. Thus, understanding the ideas requires *less* memorization of formulas, helps to remember how to approach problems better, and provides a more permanent recall of the subject.

There are important consequences of this point of view. One is that *exam problems may not simply be textbook problems* with different numbers since their purpose is to test understanding of what procedures to use and *why* they are appropriate, not just to see if you have practiced solving problems by certain techniques. Therefore, the actual answer to a problem is not as important as the approach and method you use. Because of this, *to get credit for solutions you* ***must*** *use the notation, approaches, and methods that have been presented in class—they are the primary content of the course—****regardless*** *of what you may have learned before, or what may be done differently in the textbook.*

It is also important to understand that the midterm problems are *based on how I have covered the material.* That is, you are responsible for what is covered in class (and the notation used in class), so it is *very* important to attend class. The textbook is a useful reference, should be read, and presents different examples from those in class. However, to see exactly what I do, what I believe is important, and what kind of examples I present, it is best to be in class, even if the early material is familiar to you. In my experience, it is extremely rare for a student who does not attend class regularly to do well in the course.

Advice

It is very important to keep up with the material when presented, and difficult to catch up in any math course when behind. If you have already had some Calculus there is a danger that you will be overly confident about your mastery of the material, so treat it as if you have not seen it before. If you are having any difficulties then see me about them: do not wait to see if things become clear to you over time. I am available often throughout the week (other than "office hours") and will try to accommodate your schedule.

The most important advice I can give you is to spend time *studying the lecture material* and *working on* the exercises. Most people cannot learn mathematics simply by seeing it done: they must work on it themselves. Hence, getting answers to problems from other sources—online, friends, the Math Center— may help with finding solutions to homework problems, but *will not* help you to do problems on the exams. That is, once again, the reason for working on problems is to understand the material and appropriate procedures, not to "get an answer" (but it is preferable to do so). The best way to approach problems is to ask yourself how the problem is related to the material and examples presented in class. A four-unit course is supposed to require about seven or eight hours of your time, *out of class, every week*. If you spend appropriate the time on course then you will find the material more understandable, the course more enjoyable, and the exams easier.

Academic Integrity Statement

Your work on exams is to be your work alone. Calculators, books, or notes are not to be used in midterms (and likely in the final exam) and no communication with anyone other than the proctor is allowed. Electronic devices must be turned off during exams. For the graded homework problems you are not to copy solutions from anyone else or from any other source, especially the internet or the Math Center—this includes changing notation or rearranging the order in a solution. You may discuss the general approach to graded homework problems with others, including me or the TA. I will be happy to offer help and hints. Violation of these policies is a VERY serious offense.

REVIEW PROBLEMS

pp. 9 – 10 # 20 – 28 (even only), 44, 45, 47 – 49. pp. 22 – 24 # 17, 24, 32, 42, 61, 62.

A. Find all real numbers that satisfy: i) $|x + 3| \geq 2$; ii) $|x - 2| \leq |x + 3|$; iii) $|x^2 - 1| < 1/2$? (Interpret $|\cdot|$ as distance!)

B. i) For which $x \in \boldsymbol{R}$ (real numbers) is $(x^2)^{1/2} = x$? ii) For positive $x, y \in \boldsymbol{R}$, show $(x + y)^{1/2} \leq x^{1/2} + y^{1/2}$.

C. For $a, b \in \boldsymbol{R}$ show that $|a + b| \leq |a| + |b|$.

D. Find the domain of $g(x) = (3 - x)^{1/2}/(x(x + 1)^{1/2})$.

E. By using the definitions of increasing and decreasing, show that the composition of two increasing functions is increasing. Is the composition of two decreasing functions a decreasing function? an increasing function?

F. What are the possible shapes for the graph of a polynomial of degree five?

G. i) Solve in $\boldsymbol{R}$: $\dfrac{x+1}{x-1} > x$; Fully factor: ii) $x^3 - 1$; iii) $x^3 + x^2 + x + 1$; iv) $x^8 - 1$; v) $x^6 + 1$; vi) $x^6 - 6x^4 + 12x^2 - 8$.

H. What is the equation of the tangent to the circle $x^2 + y^2 = 5$ through (2, 1)? Do not use Calculus!

I. For $x \neq 0, 1$, let $g(x) = 1/(1 - x)$. Compute the compositions $g \circ g$ and $g \circ g \circ g$. What is $g \circ g \circ g \circ g \circ g \circ g \circ g \circ g$?

J. Is $x^3 + \left(\dfrac{(\sin x + \cos x)^2 + 1}{\sin(2x) + 2}\right)^2$ a polynomial function for all real numbers? Justify your answer.

K. What is the maximal possible number of intersections of the graphs of $y = x^2 + ax + b$ and $y = x^6 + c_5 x_5 + \cdots + c_1 x + c_0$, and why?