

CALCULUS AND ANALYTIC GEOMETRY I.  
MATH 140, SECTION 4

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**Office:** Hawthorn 119.

**Office hours:** Monday, Wednesday and Friday, 10:00AM - 11:00AM and 02:00PM  
- 03:00PM or by arrangement.

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**Text:** *Essential Calculus, Early Transcendentals*, J. Stewart, Brooks-Cole, 2006.

**Calculator:** Calculators are not allowed for any in-class assessment such as the  
final, midterms or in-class quizzes.

**Grades:** The grading scheme is the following:

Quizzes	weekly	<b>no re-grade</b>	100pts (total)
WeBWorK	1 or 2 per week	<b>retry-able</b>	100pts (total)
Midterm 1	Thursday, September 28	<b>re-grade</b>	100pts
Midterm 2	Thursday, October 26	<b>re-grade</b>	100pts
Midterm 3	Thursday, November 16	<b>re-grade</b>	100pts
Final Exam	Monday, December 18 in 144 Hawthorn at 1pm	<b>no re-grade</b>	200pts
<b>Total</b>			<b>700pts</b>

**Re-Grades:** There are no re-grades for quizzes or the final exam. There are  
however re-grades for the midterm exams. The re-grades are entirely optional.  
To make sure that your re-grade is considered, you should follow these steps.

1. Each question you want to get re graded should be on a **separate** page  
or pages. Multi-part questions can go on the same page.
2. Show **all** your work for the question.
3. Attach all the re-grade pages together using either staples or a paper-clip  
and slip the re-grade into the exam.
4. You **must** include your original exam. No original, no re-grade.

If your re-grade is entirely correct, then you can receive 50% of the points remaining for the question. Thus, a question that you originally got 4/10 for would (if you did the re-grade correctly) get  $4/10 + 1/2 \times (10 - 4)/10 = 7/10$  points after the re-grade.

**The Course:** This course is designed as a first course in calculus. The course begins with the definition of limits and continuity including the various consequences such as the Intermediate Value and Extreme Value Theorems. After that we come to the definition of the derivative and the various methods for computing the derivative such as the product, quotient and chain rules. We also touch on the derivatives of the transcendental functions such as the exponential, logarithmic, sine, cosine and tangent functions as well. Applications to finding the derivative of functions defined as the solution of some equation in two variables (implicit functions) as well as to physics, economics and biology via the interpretation of the derivative as the rate of change are introduced.

More challenging applications follow with the Mean Value and Fermat's Theorems which form the basis for using calculus to solve problems in optimization. Convexity and concavity are introduced as a further application of the Mean Value Theorem and as an aid to optimization. Curve sketching is also discussed using the geometric information gleaned from the first and second derivatives.

Moving to antiderivatives, we introduce the Riemann sum and the definite integral. The relation to the derivative is provided through the Fundamental Theorem of Calculus. Extensions via the Substitution Rule are used to derive some of the properties of the logarithm.

The last section of the course deals with applications of integration to area and volume problems, including volumes of revolution, work and averages

**Course Objectives:**

**At the end of this course you should be able to:**

- Use the definition of a limit to verify that a given number is a limit of a given function at a given point
- Verify that a given function is continuous either at a given point or on a given domain
- Find approximate solutions to an equation by using the Intermediate Value Theorem.
- Find the derivative of a function by using the sum, difference, power, product, quotient or chain rules as appropriate, starting from the derivatives of the powers of  $x$ , the exponential or logarithmic or the trigonometric functions.
- Use the chain rule to find the derivative of an implicitly defined function.
- Find the higher derivatives of a function.
- Use Fermat's Theorem to find the critical points of a function.

- Use the first derivative test to find where a function is increasing or decreasing and so to categorize critical points as local extrema or points of inflection.
- Use the second derivative test to categorize critical points as extrema and to find intervals where the function is concave up or concave down.
- Solve optimization problems using these techniques
- Sketch graphs of functions using these techniques
- Use the Riemann integral to express various quantities in terms of definite integrals.
- Use the Fundamental Theorem of Calculus to compute definite integrals for polynomial, trigonometric and simple rational functions
- Use the Substitution Rule to calculate indefinite and definite integrals.
- Use definite integrals to compute areas between curves
- Use definite integrals to compute volumes of bodies of revolution
- Use definite integrals to compute volumes of bodies of revolution by the method of cylindrical shells.

**Lecture Outline:** The tentative schedule for the semester is:

WEEK 1: 09/06, 09/07, 09/08

Wednesday: 1.3 Limits of Functions (I)

Thursday: 1.3 Limits of Functions (II)

Friday: 1.4 Calculating Limits (I)

WEEK 2: 09/11, 09/13, 09/14, 09/15

Monday: 1.4 Calculating Limits (II)

Wednesday: 1.5 Continuity (I)

Thursday: 1.5 Continuity (II)

Friday: 1.6 Limits at Infinity; Horizontal Asymptotes

WEEK 3: 09/18, 09/20, 09/21, 09/22

Monday: 2.1 Derivatives and Rates of Change (I)

Wednesday: 2.1 Derivatives and Rates of Change (II)

Thursday: 2.2 The Derivative as a Function

Friday: 2.3 Basic Differentiation Formulae

WEEK 4: 09/25, 09/27, 09/28, 09/29

Monday: 2.4 The Product and Quotient Rules (I)  
Wednesday: 2.4 The Product and Quotient Rules (II)  
Thursday: Exam 1  
Friday: 2.5 The Chain Rule (I)

WEEK 5: 10/02, 10/04, 10/05

Monday: 2.5 The Chain Rule (II)  
Wednesday: 2.6 Implicit Differentiation (I)  
Thursday: 2.6 Implicit Differentiation (II)

WEEK 6: 10/09, 10/11, 10/12, 10/13

Monday: 2.7 Related Rates  
Wednesday: 2.8 Linear Approximation and Differentials  
Thursday: 3.2 Inverse Functions and Logarithms (I)  
Friday: 3.2 Inverse Functions and Logarithms (II)

WEEK 7: 10/16, 10/18, 10/19, 10/20

Monday: 3.3 Derivatives of Logarithmic and Exponential Functions (I)  
Wednesday: 3.3 Derivatives of Logarithmic and Exponential Functions (II)  
Thursday: 4.1 Maximum and Minimum Values (I)  
Friday: 4.1 Maximum and Minimum Values (II)

WEEK 8: 10/23, 10/25, 10/26, 10/27

Monday: 4.2 The Mean Value Theorem  
Wednesday: Review  
Thursday: Exam 2  
Friday: 4.3 Derivatives and the Shape of a Graph (I)

WEEK 9: 10/30, 11/01, 11/02, 11/03

Monday: 4.3 Derivatives and the Shape of a Graph (II)  
Wednesday: 4.4 Summary of Curve Sketching (I)  
Thursday: 4.4 Summary of Curve Sketching (II)  
Friday: 4.5 Optimization Problems (I)

WEEK 10: 11/06, 11/08, 11/09, 11/10

Monday: 4.5 Optimization Problems (II)  
Wednesday: 4.7 Antiderivatives (I)

Thursday: 4.7 Antiderivatives (II)

Friday: 5.1 Areas and Distance (I)

WEEK 11: 11/13, 11/15, 11/16, 11/17

Monday: 5.1 Areas and Distance (II)

Wednesday: Review

Thursday: Exam 3

Friday: 5.2 The Definite Integral (I)

WEEK 12: 11/20, 11/21

Monday: 5.2 The Definite Integral (II)

Tuesday: 5.3 Evaluating the Definite Integral

WEEK 13: 11/27, 11/29, 11/30, 12/01

Monday: 5.4 The Fundamental Theorem of Calculus (I)

Wednesday: 5.4 The Fundamental Theorem of Calculus (II)

Thursday: 5.5 The Substitution Rule (I)

Friday: 5.5 The Substitution Rule (II)

WEEK 14: 12/04, 12/06, 12/07, 12/08

Monday: 7.1 Area Between Curves (I)

Wednesday: 7.1 Area Between Curves (II)

Thursday: 7.2 Volumes (I)

Friday: 7.2 Volumes (II)

WEEK 15: 12/11, 12/13, 12/14, 12/15

Monday: 7.3 Volumes By Cylindrical Shells (I)

Wednesday: 7.3 Volumes By Cylindrical Shells (II)

Thursday: 3.7 L'Hospital's Rule

Friday: Review

WEEK 16: 12/18

Monday, 144 Hawthorn at 1pm

**Attendance: Experience has shown that if you miss more than 10% or so of the lectures, you're likely to fail.**

**Lectures:** Take lecture notes. People who have tried to understand everything in class without taking lecture notes **fail the course**. Taking lecture notes means that you have a record that you can refer to later.

**Snow Days:** See my webpage or call my phone for a recorded message to see if class is cancelled. It is highly unlikely that I will cancel but the University won't.

**Academic Integrity Definition and Expectations:** Academic integrity is the pursuit of scholarly activity in an open, honest and responsible manner. Academic integrity is a basic guiding principle for all academic activity at The Pennsylvania State University, and all members of the University community are expected to act in accordance with personal integrity, respect other students' dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts.

Academic integrity includes a commitment not to engage in or tolerate acts of falsification, misrepresentation or deception. Such acts of dishonesty violate the fundamental ethical principles of the University community and compromise the worth of work completed by others. (*Policies and Rules for Students, Section 49-20.*)

**Consequences of academic dishonesty:** The instructor may assign an academic sanction ranging from a warning to failure on an assignment or in the course or to removal from the course. (Note that a failure in a course may affect a student's status in a program and/or in the University.) The instructor reports each academic sanction to the Office of Judicial Affairs, which keeps a record. Students can appeal academic sanctions to the Committee on Academic Integrity through the Office of Academic Affairs. In more serious cases of academic sanctions of academic dishonesty, the Office of Judicial Affairs may apply disciplinary sanctions in addition to the academic sanctions. These may range from a warning to probation, suspension or expulsion from the University. An "XF" grade is a formal University disciplinary sanction indicating on the student's transcript that failure in a course was due to a serious act of academic dishonesty. (*Policies and Rules for Students, Section 49-20 and Academic Integrity Procedure G-9.*)