Mathematics S112E
Calculus of Functions of One Variable I

Course Orientation and Tentative Syllabus, Summer 2017

Instructor	Dr. John Hall	john.hall@yale.edu
TA	Gabriel Bergeron-Legros	gabriel.bergeron-legros@yale.edu

Course Description

The objective of this course is to introduce the notions of derivative and of definite integral for functions of one variable, with some of their physical and geometrical motivation and interpretations. Emphasis will be placed on acquiring an understanding of the concepts that underlie the subject, and on the use of those concepts in problem solving.

Prerequisites

To succeed in this course, you should have a firm grounding in algebra and precalculus mathematics, as demonstrated on the math department's placement exam (see below). No prior acquaintance with calculus is assumed.

Placement and Sectioning

Before you enroll in Math 112, you must complete the ALEKS assessment. If you wish to take Math 112 this term but do not place into the course, please contact John Hall.

Textbook and References

- Stewart, *Calculus, Early Transcendentals*, 8th edition, Cengage Learning. **(Required.)**
- WebAssign. This is a software package that provides online problems. **(Required.)**

Note: The textbook and WebAssign can be purchased as a package for $111.75 from the publisher at http://www.cengagebrain.com/course/2438287. If you can get the textbook from some other source for less than $17.75, or don't wish to have a hardcopy at all, you may choose to purchase WebAssign access (which includes the ebook) for $94 directly from WebAssign.

Key Topics

Here are some of the main mathematical topics to be covered in Math 112, to give you a flavor of the course:

- Limits and Continuity
- Derivatives
- Implicit Differentiation
- Related Rates
- Linear Approximation
- Differential Equations

- Curve Sketching
- Optimization
- Antiderivatives
- Definite Integrals
- The Fundamental Theorem of Calculus

Homework

Problems are an essential part of the course; it is virtually impossible to learn the material and to do well in the course without working through the homework problems in a thoughtful manner. The only way to learn math is to do math. Don't just crank through computations and write down answers; *think* about the problems posed, the strategy you employ, the meaning of the computations you perform, and the answers you get. It is often in this reflection that the greatest learning takes place.

Problems sets will be posted on the course website. Typically there will be an assignment due each class. One assignment per week is to be written up and handed in at the beginning of class, while the remaining assignments will be completed online via WebAssign. All due dates should be clear from the course web site. If you must miss a class, you are responsible for handing the assignment in on time; **late homework will not be accepted**.

Discussing mathematics is a very effective way to learn, and we encourage you to work with other students on the homework. However, any work you submit should be written up on your own, and you should be able to explain and develop anything you have done in a group. We also request that if you do a significant part of your homework in a group, please write the name(s) of your study partner(s) on the first page of your assignment.

Homework Presentation and Grading (handwritten work)

It is important to be able to communicate mathematics effectively, especially when you are using it as a tool for application in other disciplines. In simple homework computations, you should show and justify the key steps; in more open-ended or longer homework problems, please explain your thinking clearly. Your homework should be presented in a professional manner. In particular,

- submit questions in the order that they were assigned
- explain any notation that you introduce, and include diagrams, sketches, tables and graphs as appropriate
- state your final answer clearly if doing a computation

Most written homework questions will be graded on a 3-point scale, according to the rubric below.

3 points	Work is completely accurate, essentially perfect. Ideas are fully developed. Work is neat and easy to read. Complete sentences are used where appropriate.
2 points	Work is good, on the right track, but development of ideas is incomplete. Work is hard to read or disorganized.
1 point	Work is sketchy, with some correct ideas, but mostly on the wrong track. Work is messy or illegible.
0 points	Work is minimal or non-existent. No explanations are given. Answer is completely incorrect.

A Comment about Homework

Try to think of homework as a way to gain a deeper understanding of the material, rather than as a set of isolated problems. Ask yourself how concepts and techniques from different homework sets relate to each other. When your homework is returned to you, read through your grader's comments and make sure you understand how you could improve. Rewriting answers in the light of your grader's feedback is an excellent exercise. If you still have questions after you have reflected on your homework carefully, be sure to follow up on them!

Exams

The midterm exam will be given on Monday, July 17, and the final on Friday, August 4. There will also be a differentiation quiz, which you will take online via WebAssign.

Calculator Policy

You should feel free to use a calculator or computer to check or investigate problems for homework. However, you should not rely on calculators and computers to the extent that you lose fluency with the material and do not develop your own computational skills. Use the calculator as a learning tool, not as a crutch. Calculators will not be allowed on examinations. We will make sure that problems on the exams require only a moderate amount of calculation to allow you to spend most of your time demonstrating your mathematical knowledge.

Grading

The grading policy is designed so that you can represent your mastery of the material in the most favorable light. Your course grade will be determined as follows:

- Course Score: Take the higher of:
  - 45% Final Exam + 35% Midterm Score + 5% Quiz Score + 15% Homework
  - 60% Final Exam + 20% Midterm Score + 5% Quiz Score + 15% Homework

In the computation of your letter grade for the course, your numerical score on exams is used. We do not convert your exam scores to letter grade to compute. Semester numerical scores will be converted into letter grades according to the following scale: $100 \geq$ A, A- $\geq 90 >$ B+, B, B- $\geq 80 >$ C+, C, C- $\geq 65 >$ D $\geq 50 >$ F

Getting Help

Many resources are available to you to support you through this course. Not least among these are your fellow students, and, of course, the instructional staff are always ready to work with you. Please get to know us and each other early in the semester, and familiarize yourselves with the different ways to get help. Some of these are:

- Office Hours: Time and location TBA. Your instructor and TA will hold regular online office hours every week, and you should feel free to chat about any questions or concerns that you have.
- Study Groups with Peers: You are strongly advised to form study groups with your classmates. Discussion and collaboration are among the best ways to learn mathematics.

Tentative class-by-class syllabus

Week 1.
- Monday, July 3

  §§1.1, 1.2, 1.3, Appendix D, 1.4, 1.5: Four Ways to Represent a Function; Mathematical Models: A Catalog of Essential Functions; New Functions from Old Functions; Trigonometry; Exponential Functions; Inverse Functions and Logarithms.
- Wednesday, July 5

  §§2.1, 2.2: The Tangent and Velocity Problems; The Limit of a Function.
- Friday, July 7

  §§2.3, 2.5: Calculating Limits Using the Limit Laws; Continuity.

Week 2.
- Monday, July 10

  §§2.6, 2.7: Limits at Infinity: Horizontal Asymptotes; Derivatives and Rates of Change.
- Wednesday, July 12

  §§2.8, 3.1: The Derivative as a Function; Derivatives of Polynomials and Exponential Functions.
- Friday, July 14

  §§3.2, 3.3, 3.4: The Product and Quotient Rules; Derivatives of Trigonometric Functions; The Chain Rule.

Week 3.
- Monday, July 17

  Midterm
- Wednesday, July 19

  §§3.5, 3.6, 3.9: Implicit Differentiation; Derivatives of Logarithmic Functions; Related Rates.
- Friday, July 21

  §§3.10, 9.1, 9.2: Linear Approximation; Modeling with Differential Equations; Direction Fields and Euler's Method

Week 4.
- Monday, July 24

  §§4.1, 4.2, 4.3: Autonomous Differential Equations; Maximum and Minimum Values; The Mean Value Theorem; How Derivatives Affect the Shape of a Graph.
- Wednesday, July 26

  §§4.4, 4.5, 4.7: Indeterminate Forms and l'Hospital's Rule; Summary of Curve Sketching; Optimization Problems.
- Friday, July 28

  §§4.7, 4.8, 4.9: Optimization Problems, continued; Newton's Method; Antiderivatives.

Week 5.
- Monday, July 31

  §§5.1, 5.2: Areas and Distances; The Definite Integral.
- Wednesday, August 2

  §§5.3, 5.4: The Fundamental Theorem of Calculus; Indefinite Integrals and the Net Change Theorem.
- Friday, August 4

  Final Exam