# 21-120 : Differential and Integral Calculus
# Summer I 2010


| | |
|---|---|
| Instructor: | Will Gunther |
| Email: | wgunther@math.cmu.edu |
| Office: | Wean 6211 |
| Office Hours: | After class till 1pm or by appointment |
| Course Dates: | May 17-June 24, 2010 |
| Lecture Times: | Weekdays 10:30-11:50 |
| Lecture Place: | Wean 8427 |
| Textbook: | *Essential Calculus: Early Transcendentals* by Stewart |


**Introduction:** This course is designed to be a first course in differential and integral calculus. Calculus is a branch of mathematics where the primary questions has to do with *rates of change*. It has applications in all areas of applied science and engineering.

**Prerequisites:** A good grasp of algebra and trigonometry is essential for success in the course. Also, you should have a clear intuition on geometric concepts as these are the motivating questions.

**Course Objectives:** You are responsible with having a firm grasp of the following by the end of the course:

- Being an expert in basic algebra, especially in understanding what the concept of a function, and know basic laws of exponentials and logarithms and knowing basic trigonometry
- Understanding the definition of a limit, knowing how to take limits, knowing when a limit does not exist, knowing the properties and laws of limits,
- Knowing the limit definition of continuity, determining whether a function is continuous, knowing the intermediate value theorem and it's applications
- Knowing what a tangent line is, knowing what a secant line is, being able to determine average rates of change using secant lines
- Being able to use the limit definition of derivatives, Being about to determine the derivative of a function using the limit definition of the derivative, Being able to give the equation for the tangent line using the limit definition of the derivative.
- Knowing and using the rules for derivatives (power rule, product rule, quotient rule, chain rule), knowing the derivative of trig functions and exponentials
- Knowing how do differentiate implicit functions and take higher derivatives.
- Doing linear approximations using tangent lines, knowing and being able to use the mean value theorem.
- Finding extrema of a function, sketching the graph of a function, knowing how optimize and other applications of differential calculus
- Knowing what an anti-derivative is, knowing techniques for how to take anti-derivatives (parts, trig-substitution, u-substitution)
- Knowing and being able to use the Fundamental Theorem of Calculus, understanding the relationship between integration and differentiation and the area under the curve of a function
- Knowing and being able to find the exact area under the curve of a function, knowing and being able to find the exact area between two functions.
- Being able to find the volume of a solid of revolution (discs and shells) and over a region of the plane
- Know what a differential equation is, and how to solve very basics ones.

**Assignments:** There will be homeworks assigned weekly due every Monday. You will be given the assignment one week before it is due. You must show all your work to get full credit. Not all problems may be completely graded for credit. Late homework is never acceptable, but you may hand in your homework early if you plan on missing a Monday class.

**Quizzes:** There will be frequent announced and unannounced quizzes given class. This will usually only be one easy question on the things taught the previous class. Each quiz will be out of 3 points: 0 for did not take, 1 for completely wrong but did take (an attendance point basically), 2 for almost right, and 3 for completely right. There will be about three quizzes every week. There will be three quizzes dropped.

**Exams:** There will be an 80 minute, closed books/notes, midterm and a final exam. These account for the majority of your grade in this course. The midterm is scheduled for June 9th, which is roughly midway through the semester. The final will be June 25th.

They will not by *explicitly* comprehensive, but by the nature of the course if you don't have a full understanding on the midterm you will probably not do well on the final exam.

You may take the exam before the scheduled date with my permission, but you must take it the week of the scheduled date. Makeups after the date of the scheduled exam will **only** be given in the case where you can provide documented proof of an emergency of illness.

**Grades:** Your grade will be based on all the above work, and only that work. There's no room for extra credit, or anything like that. The grade breakdown will be as follows:

| | | |
|---|---|---|
| Homework: | 20% | *5 total assignments* |
| Quizzes: | 20% | *≈18 total, lowest 3 dropped* |
| Midterm: | 30% | |
| Final Exam: | 30% | |

The grades will be assigned on the standard scale:

| | |
|---|---|
| A | 90-100% |
| B | 80-89% |
| C | 70-79% |
| D | 60-69% |
| R | $< 60\%$ |

**Course Policies and Advice**

- Calculators are *never* to be used on any in-class assignment. You may check your homework with a calculator, but work must be shown. Calculators often slow work and are a crutch for understanding topics and procedures.
- Attendance is strongly encouraged, especially considering 20% of your grade will be determined by quizzes, which will frequently be unannounced.
- If you do not understand something in class, please ask. Odds are, if you do not understand something then others in the class do not. If you are not willing to speak up during class, you should ask me during my office hours.
- Do not wait till the last minute for anything. The homework will take time. Exams will creep up on you. Time is not a virtue in a summer class.
- **Academic Honesty:** All work handed in by you, whether in class or homework, must be the work of yourself and no one else. This will be strictly enforced. The penalty for any violation will be at least a 0 on that assignment.
- **Special Needs:** If you have documentation supporting the needs for special accommodations (extra time on tests, special seating, etc) then you must present it with be as soon as possible. The day of the test is not acceptable. I will assist with any reasonable requests.

**Important Dates:**

| | |
|---|---|
| May 17: | Class Begin |
| May 21: | Drop Deadline |
| May 31: | Memorial Day; No Classes |
| June 9: | Midterm Exam |
| June 24: | Last Day of Class. Withdrawal Deadline |
| June 25: | Final Exam |

**Course Calendar (tentative)**:

| May | | | | | | |
|---|---|---|---|---|---|---|
| Sun | Mon | Tue | Wed | Thu | Fri | Sat |
| | | | | | | 1 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 §1.1-2 Functions | 18 §1.3-4 Limits | 19 §1.5-6 Continuity | 20 §2.1-2 Tangents and Derivatives | 21 §2.3-4 Derivative Rules | 22 |
| 23 | 24 §2.4-5 Chain Rule | 25 §2.6-7 Implicit Differentiation | 26 §2.8-3.1 Linear Approximations | 27 §3.2-3 Logs, Exponentials, and Inverses | 28 §3.4-5 Exponential Decay and Inverse Trig | 29 |
| 30 | 31 **Memorial Day** | | | | | |

| June | | | | | | |
|---|---|---|---|---|---|---|
| Sun | Mon | Tue | Wed | Thu | Fri | Sat |
| | | 1 §3.7 L'Hôpital's Rule | 2 §4.1-2 Extrema and MVT | 3 §4.3-4 Graph Shapes and Sketching | 4 §4.4-5 Sketching + Optimization | 5 |
| 6 | 7 §4.7,5.1 Anti-derivatives | 8 Workshop Day | 9 **Midterm** | 10 §5.2-3 Definite Integrals | 11 §5.4 Fundamental Thm of Calculus | 12 |
| 13 | 14 §5.5 u-substitution | 15 §6.2 Trig-substitution | 16 §6.3 Partial Fractions | 17 §6.1 Parts | 18 §7.1 Area Between Curves | 19 |
| 20 | 21 §7.2-3 Volume | 22 §7.2-3 Volumes of Solids of Revolution | 23 §3.6,7.6 Volumes and Applications | 24 Workshop Day | 25 **Final Exam** | 26 7 |
| 27 | 28 | 29 | 30 | | | |