

21-122: Integrals, Differential Equations, and Approximations

Summer I 2013

Course Information

Course Title: Integrals, Differential Equations, and Approximations

Course Number: 21-122

Course Website: <http://math.cmu.edu/~wgunther/122m13/>

Class Time: 9:00am - 10:20am

Class Location: Wean 6423

Instructor: William Gunther

Email: wgunther@andrew.cmu.edu

Office: Wean 6211

Office Hours:

- Everyday after class in office, some evenings via Google Hangout.
- By Appointment.

Course Objectives

At the end of this course, you will be able to do the following skills:

- Use different integration skills, such as integration by parts, trigonometric substitution, and partial fractions.
- Recognize which integration techniques to use given an integral out of context.
- Understand Riemann sums, and how they relate to the definition of the integral.
- Use partial Riemann sums, the midpoint rule, trapezoidal rule, and Simpson's rule to approximate an integral.
- Compare the different methods of approximations.
- Calculate the maximum error in an approximation.
- Understand improper integrals.
- Evaluate improper integrals.
- Set up and calculate work problems.
- Set up and calculate center of mass problems.
- Solve separable differential equations.
- Understand two models of population growth (exponential and logistic) and how they are modeled as a differential equation.
- Use Euler's Method to approximate the solution to a differential equation.
- Use Newton's Method to find roots of functions.
- Understand what a sequence is.
- State and use the monotone sequence theorem.
- State and use the squeeze theorem.
- Be able to recognize convergence and divergence sequences.
- Understand the formal definition of a series in terms of sequences of partial sums.
- Use the convergence tests to recognize convergent series.
- Be able to recognize absolutely convergent series.
- Understand what a power series is.
- Calculate a power series which converges to a function $f(x)$ using geometric series.
- Calculate a power series which converges to a function $f(x)$ using Taylor's Theorem.
- Understand what a parameterized function is.
- Be able to parameterize a function.
- Calculate the arc length of a function.
- Understand the polar coordinate system.
- Be able to convert between rectangular and polar coordinates.

- Do integration in polar coordinates.
- Understand what a vector is in \mathbb{R}^2 and \mathbb{R}^3 .
- Calculate the dot product and cross product of vectors.
- Understand the geometry of the dot product and cross product.
- Understand equations for lines and planes.
- Find the equations for lines and planes.

Course Policies and Advice

Policies

- **Test Resource Policy:** Outside resources are not permitted on tests. This includes any electronics, books, notes, etc.
- **Homework Resource Policy:** Because people often benefit from seeing many different sources of material, you are welcome to consult different resources not listed on the course website to study and do homework. Such consultation will not be necessary, and all assignments and tests are written to be done without any resources except the required resources. You may not try to find and use an outside source just to answer to a particular problem. For example:
 - Legal Use of Outside Resources: You are stuck on a particular homework problem. Because you are stuck, you realize you may have not known that topic as well as you thought you did. The sources I have provided don't seem to be explaining it to your satisfaction, so you consult an outside source, which clears up your confusion and allows you to do the problem.
 - Illegal Use of Outside Resources: You are, as above, stuck on a particular homework problem. You try searching the question on a search engine, until you find a source which provides an answer to the question. You then paraphrase or copy the answer provided to be turned in.
- **Attendance Policy:** You are expected to come to 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, but may include more harsh punishments governed by university policy.
- **Collaboration Policy:** You are encouraged to collaborate. Productive collaboration is a necessary skill to acquire. But, no permanent record of the discussions are allowed (we call this the *White Board Policy*). Moreover, you must cite all collaborators. The penalty for any violation will be at least a 0 on that assignment. For example:
 - Legal Collaboration: You and two friends discuss a problem, all making notes only on a white board. Once you feel like you understand the problem, the white board is erased, and you leave with no permanent notes taken from the meeting. Later, you write up the solution on your own.
 - Illegal Collaboration: You and a friend discuss a problem. You figure it out together, and then compare notes and consult each other while writing up your solutions.
- **Special Needs:** If you have documentation supporting the needs for special accommodations (extra time on tests, special seating, etc) then you must present it to me during the first week of class. I will assist with any reasonable requests.
- **Syllabus Changes:** I reserve the right to make any changes to this syllabus during the course of the semester to make the grading more fair or the course more productive.

Advice

- This course has prerequisites. That knowledge will be assumed, mostly without any class time devoted to review. If you feel that you do not adequately understand material that is a prerequisite you should work on that material as soon as possible. Please see me for more particular guidance.
- If you do not understand something in class, please ask. Odd are, if you are confused then others in the class are also confused. You are also free to discuss any confusions or problems during my office hours.
- Do not wait till the last minute for anything. The homework will take time. Quizzes will creep up on you. Time is not a luxury we have in a summer class.

- My office hours will be 6 days a week. Please talk to me if you have any concerns or need any help with the course. You can also come if you just want to say hi. If you cannot make any of the times and you'd like to meet with me, send me an email and we meet at a time when you are available.

Grades and Assessments

Assessments

There will be two primary methods of assessment: homework and quizzes.

Homework

Homework is meant to be primary for your benefit, and is meant to ensure that you are keeping up with the course and doing problems. There will be daily homework meant to be due the day after the material is learned (the Friday homework will be due the following Monday).

The online homework will be assigned through the WebAssign system (<http://webassign.net>). The class key for this class is:

cmu 6495 9024

There will also be paper homeworks. They will be due every Friday (except for the last). Although they will be collected weekly, the problems will be assigned daily.

Quizzes

Quizzes are meant to be primary for the assessment of your skills. There will be a quiz every week, except the first. The quiz will take about half of the class period (40 – 50 minutes). All quizzes will be on the Monday, and they will test the material covered the previous week. Although they will not be cumulative, as it is a course which build on past material, you may have the use techniques learned earlier in the course or material learned in prerequisite courses (namely, 21-120).

Final Exam

There will be one final exam which will be a full 80 minute exam on the last day of class. The exam will have two components: the first will be a 40 minute component which will act as a quiz on the last week of material. The other is a 40 minute cumulative component which will test the material from the entire course.

Grades

Your grade will be based on all the above assessments, and only those assessments; there's no possibility for extra credit. The following is how the assessments are proportioned to form your grade.

Online Homework:	5%	≈ 25 total
Paper Homework:	25%	
Quizzes:	50%	5 quizzes at 10% each
Final Exam:	20%	

So each homework is worth about 1.5% of your grade, each quiz is worth 10% of your grade, the final is worth two quizzes.

Grade Cutoffs

The following is the grade cutoffs I will try to follow. They may be lowered at the end of the course:

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