# 21-122: Integration and Approximation, Lecture 2

Carnegie Mellon University Department of Mathematical Sciences Spring 2024 Syllabus

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- **Note:** The information presented in this course syllabus is subject to change (with notification) at the discretion of the Instructor.
- **Course Website:** Course materials, assignments, and announcements will be available at the course Canvas website https://canvas.cmu.edu/. Students are responsible for checking the site regularly for any information relevant to the class.
- Lecture Meetings: 10:00am–10:50am MWF in Porter Hall 100.
- Recitation Meetings:
  - Section E: 9:00am-9:50am TR in Porter Hall A18A
  - Section F: 11:00am-11:50am TR in Baker Hall 237B
  - Section G: 2:00pm-2:50pm TR in Baker Hall 237B
  - Section H: 3:00pm-3:50pm TR in Porter Hall A18A
  - Section I: 4:00pm–4:50pm TR in Doherty Hall 1112
- **Textbook:** OpenStax Calculus, Volume 2 by Herman and Strang. This book is available electronically via the Canvas course or online at https://openstax.org/details/books/calculus-volume-2. We will cover most of Chapters 1, 3, 4, 5, 6, 7 textbook and one section in Chapter 2. Note: Lecture material will be available electronically via the Canvas course.
- **Catalog Course Description:** (10 units) Integration by trigonometric substitution and partial fractions; arclength; improper integrals; Simpson's and Trapezoidal Rules for numerical integration; separable differential equations, Newton's method, Euler's method, Taylor's Theorem, including a discussion of the remainder, sequences, series, power series. Parametric curves, polar coordinates, vectors, dot product. **Prerequisites:** 21-120 or 21-112. **Note:** You are expected to know, coming into this course, how to find basic antiderviatives or indefinite/definite integrals, how to use *u*-substitution to find antiderivatives, and how to integrate by parts.
- **Student Learning Outcomes:** At the completion of this course, students will be able to:
  - 1. Evaluate or approximate integrals using the most efficient technique.
  - 2. Recognize and evaluate improper integrals.
  - 3. Determine the convergence or divergence of infinite sequences and series.
  - 4. Find the radius and interval of convergence of a power series.

- 5. Approximate functions with Taylor polynomials.
- 6. Recognize, construct and plot functions defined parametrically or in polar coordinates.
- 7. Determine the arc length of, and area underneath/within for polar and parametric curves
- 8. Have a basic understanding of differential equations and their application to modeling realworld phenomena.

The student will accomplish the above outcomes through attending lectures, completing several homework assignments, completing three midterm exams, and completing a comprehensive final exam. As this is an 10-unit course, students should expect to spend at least five hours per week on reading, homework, and studying, in addition to the five class meetings per week.

- **Technology:** Calculators or any other form of technology will not be allowed for use on any exam throughout this course.
- Attendance: Attendance to all lectures and recitations is expected, and students are responsible for materials covered in classes that are missed. Students should ensure that they have the contact information of a "friend" in the course so that they may ask the friend to fill them in on what went on in any missed course meetings.
- Important Dates: Please see the CMU Academic Calendar at https://www.cmu.edu/hub/ calendar/docs/2324-academic-calendar.pdf. Note that the last day to Drop this course is Monday, February 26th, and the last day to Withdraw from the course or to convert the course to Pass/No Pass is Monday, April 1st.
- Use and Distribution of Course Materials: You may download and use the course materials for individual educational use and retain them for your own individual future reference. You may not share course materials with others outside of the course or upload them online. Doing so is a copyright violation and an Academic Integrity Violation, and could result in disciplinary action, even after the course has ended.
- **Piazza:** Piazza is a forum where students can post questions, respond to each others' questions, and get responses from course staff. This is a great way to interact with other students about the course material. If you have a question, you will usually get a response on Piazza faster than if you wait for office hours or a reply to an email. **Note:** Students should not post complete solutions to homework problems on Piazza. The course staff may post partial or full solutions, but students should not do so to avoid potential academic integrity issues.
- Office Hours: Office hours are optional, drop-in sessions where the course staff can provide support and answer questions about the course material. Make the most of them! Even the very best students use office hours to strengthen their knowledge: you do not need to be struggling for office hours to be helpful. The dates, times and locations of office hours can be found on the course calendar on Canvas. Since office hours are entirely unstructured, please make sure that you follow the following guidelines:
  - Have something in mind to discuss or ask, and be as specific as possible.
  - Be mindful of others: take turns asking questions, and make space for other students if it is busy (i.e. leave the room when your questions have been answered).

## **Homework Assignments**

• **Gradescope:** We will utilize the Gradescope platform in our course for handling homework. In order to be able to upload your work to Gradescope, you will need to be able to scan your written work into

a PDF document. Please use a scanner or a phone app such as CamScanner or Adobe Scan to scan your work, and double check that the scan is legible before uploading. or else we may not be able to grade your submission. Also, when uploading to Gradescope, you must assign each problem to a page in your uploaded work, otherwise you may not receive credit for your submission.

- **Timing and Frequency:** Homework assignments will be issued weekly on Sundays, and will be due at 11:59pm on subsequent Saturdays (on Gradescope), with exceptions outlined by the instructor. It is your responsibility to ensure that your work is submitted to Gradescope successfully and on time.
- Extensions: In general extensions are not allowed as the goal is to post the homework solutions as quickly as possible after the due date. However, if there is some emergency, please email the course instructor to see if an exception can be made in your case. Late homework will not be accepted without prior authorization from the course instructor. No homework will be accepted once the solutions are posted on Canvas.
- Points: All homework assignments will be worth 50 points each.
- **Collaboration Policy:** Students are encouraged to work together to discuss homework problems and solutions, however the work a student turns in should be their own. The easiest way to ensure independence of solutions is to not write your final solution until you are by yourself. **Copying solutions is cheating and any suspected Academic Integrity Violation will be pursued.**
- Drops: Your two lowest homework scores will be dropped at the end of the semester. Note that this policy is designed for situations when you are not able to work on homework for a whole week, including when you may be ill or otherwise unavailable to work on the assignment. No other homework scores will be dropped, regardless of the circumstances. You should always submit whatever you have been able to do by the homework deadline, even if it is only part of the assignment.

### **Midterm and Final Exams**

- **Midterm Exams:** There will be three midterm exams administered throughout the semester. The dates for the exams are:
  - February 7th (Wednesday)
  - March 13th (Wednesday)
  - April 10th (Wednesday)

Some exam details:

- Missed Midterm Exams: No missed midterm exams will be made up. If a student misses an exam without a valid excuse, the grade will be zero. If a student misses an exam with a valid excuse, then the student's final exam grade will be used for the missed midterm exam grade. In the case of a scheduled university-related activity which conflicts with a scheduled exam, the student should notify the instructor ASAP (before the exam) that they will be missing the exam. Note: You must email the instructor prior to the exam if you are going to miss the exam due to illness in order for your excuse to be considered valid.
- **Use of Course Materials:** Exams are closed book and closed notes. Any suspected use of course materials during an exam will result in an Academic Integrity Violation.
- Use of Unauthorized Resources: You are not permitted to use any resources on the exams, including the internet or other individuals, during the exam. Doing so will result in an Academic Integrity Violation.

- Leaving the Classroom During an Exam: If you must leave the classroom during the exam, you must bring your phone to the front of the room and leave it with the instructor. Failure to do so will be considered an attempt to use unauthorized resources, and will result in an Academic Integrity Violation.
- Exams with Accommodations: If you are receiving exam accommodations from the Office of Disability Resources, such as extended time or a distraction-reduced environment, you must schedule your midterm exams and final exam to be proctored at the ODR Testing Center. The instructor does not have the ability to provide extended time or a distraction-reduced environment themselves.
- Final Exam: The final exam is cumulative and will cover all topics discussed throughout the semester. The final exam will be scheduled by the university and the date/time will be announced as soon as it is available. The only makeup for the final exam will be offered on the official university makeup final exam date, which is Tuesday May 7th. You will not be able to take the final exam early, for any reason. Therefore, do not make plans to leave campus for the semester until you know when the final exam is scheduled to take place.

### **Regrade Requests**

- We will grade a lot of your work throughout the semester, but (just like you) we are mere humans, so it is entirely possible that we will make an error from time to time. If we do, you can and should submit a regrade request through Gradescope. The procedure is as follows:
  - All regrade requests should be submitted via Gradescope (no email or verbal requests please);
  - Separate regrade requests should be submitted for separate questions;
  - Regrade requests for homework and midterms 1–3 open 24 hours after scores and feedback are released on Gradescope, and are due within one week. Regrade requests for the final exam open immediately when scores and feedback are released, and are due within 24 hours.

Your work will be regraded from scratch according to the same rubric – because of this, please note that it is possible for your score to increase, decrease or remain the same. Some scenarios where submitting a regrade request would be appropriate are:

- The grader overlooked some of your work, e.g. they only graded the first of two pages;
- The grader misread your solution;
- You did not receive full credit for a problem sheet solution and no feedback was left;
- The grader entered a score incorrectly on Gradescope.

You can also use the regrade request feature on Gradescope to ask the grader to elaborate on their feedback. If you want to do this, make it clear in your 'regrade request' that you are not actually requesting a regrade, just more information.

Some scenarios where submitting a regrade request would not be appropriate are:

- You disagree with how points are allocated in the rubric;
- You need to raise your score by *x* points in order to achieve a certain grade;
- Your solution requires additional explanation in order to be understood.

If you are not sure whether something is grounds for a regrade request, ask one of the course staff prior to submitting your request.

#### Grading

Grading Policy:				
	_	Final Grade		
Midterm Gr	ade	Homework	15%	
Homework	25%	Two Highest Midterm Exams (22.5% each)	45%	
First Exam	75%	Lowest Midterm Exam	10%	
		Final Exam	30%	

- Grading Scale: A: 90%–100%, B: 80%–89%, C: 70%–79%, D: 60%–69%, R: 0%–59%
- Note: Course averages and grade borderlines are exact numbers and are not rounded. Since midterm and final exam scores are already adjusted before the final course grade is computed, these grade borderlines are firm and will not change (in either direction). It is important that all students in the course be assessed and graded against the same set of criteria, and that course grades reflect the quality of work submitted over the course of the semester. As such, individual requests for grade bumps are not appropriate and will not be granted.
- Extra Credit: There will be no opportunities for extra credit in this course. Your grade will be calculated using the structure given above.
- Accommodations: If you have a disability and are registered with the Office of Disability Resources, I encourage you to use their online system to notify me of your accommodations and discuss your needs with me as early in the semester as possible. I will work with you to ensure that accommodations are provided as appropriate. If you suspect that you may have a disability and would benefit from accommodations but are not yet registered with the Office of Disability Resources, I encourage you to contact them at access@andrew.cmu.edu.
- **Resources:** Students are encouraged to take advantage of the Instructor and the TAs' office hours. If you cannot make any scheduled office hours, please send email to the Instructor or TAs to try to set up an appointment.

The Student Academic Success Center also provides tutoring for 21-122. The schedule for dropin tutoring or one-on-one tutoring can be found at https://www.cmu.edu/student-success/ programs/tutoring.html.

- Academic Integrity: The official CMU policy on Academic Integrity is available at http://www. cmu.edu/policies/student-and-student-life/academic-integrity.html and more information is available at http://www.cmu.edu/academic-integrity/index.html. All suspected violations of academic integrity will be pursued by the instructor.
- Statement of Support for Students' Health & Well-being: Take care of yourself. Do your best to maintain a healthy lifestyle this semester by eating well, exercising, avoiding drugs and alcohol, getting enough sleep and taking some time to relax. This will help you achieve your goals and cope with stress. If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support. Counseling and Psychological Services (CaPS) is here to help: call 412-268-2922 and visit https://www.cmu.edu/counseling/. Consider reaching out to a friend, faculty or family member you trust for help getting connected to the support that can help.

## **Tentative Course Calendar**

Week	Date	Day	Class Type	Content	Textbook Sec.
1	1/16/24	Т	Recitation 1	Course Syllabus, Review of u-substitution	1.5-1.7
1	1/17/24	W	Lecture 1	Substitution, Integration by Parts	1.5-1.7, 3.1
1	1/18/24	R	Recitation 2	Integration by Parts	3.1
1	1/19/24	F	Lecture 2	Trigonometric Integrals	3.2
2	1/22/24	М	Lecture 3	Trigonometric Integrals, Trigonometric Substitution	3.2, 3.3
2	1/23/24	Т	Recitation 3	Trigonometric Subsitution	3.3
2	1/24/24	W	Lecture 4	Trigonometric Subsitution, Partial Fractions	3.3, 3.4
2	1/25/24	R	Recitation 4	Partial Fractions	3.4
2	1/26/24	F	Lecture 5	Partial Fractions	3.4
3	1/29/24	М	Lecture 6	Improper Integrals	3.7
3	1/30/24	Т	Recitation 5	Improper Integrals	3.5, 3.7
3	1/31/24	W	Lecture 7	Other Strategies for Integration	3.5
3	2/1/24	R	Recitation 6	Other Strategies for Integration	3.5
3	2/2/24	F	Lecture 8	Numerical Integration	3.6
4	2/5/24	М	Lecture 9	Arc Length of a Curve and Surface Area	2.4
4	2/6/24	Т	Recitation 7	Review for Exam 1	1.all, 3.all
4	2/7/24	W	Exam 1	Exam 1 - covers Chapters 1 and 3	
4	2/8/24	R	Recitation 8	Arc Length of a Curve and Surface Area	2.4
4	2/9/24	F	Lecture 10	Sequences	5.1
5	2/12/24	Μ	Lecture 11	Infinite Series	5.2
5	2/13/24	Т	Recitation 9	Sequences and Infinite Series	5.1, 5.2
5	2/14/24	W	Lecture 12	The Divergence and Integral Tests	5.3
5	2/15/24	R	Recitation 10	The Divergence and Integral Tests	5.3
5	2/16/24	F	Lecture 13	Comparison Tests	5.4
6	2/19/24	М	Lecture 14	Comparison Tests	5.4
6	2/20/24	Т	Recitation 11	Testing Series for Convergence and Divergence	5.3, 5.4
6	2/21/24	W	Lecture 15	Alternating Series	5.5
6	2/22/24	R	Recitation 12	Alternating Series	5.5
6	2/23/24	F	Lecture 16	Alternating Series	5.5
7	2/26/24	М	Lecture 17	Root and Ratio Tests	5.6
7	2/27/24	Т	Recitation 13	Root and Ratio Tests	5.6
7	2/28/24	W	Lecture 18	Root and Ratio Tests, Power Series	5.6, 6.1
7	2/29/24	R	Recitation 14	Strategy for Testing Series	5.3-5.6
7	3/1/24	F	Lecture 19	Power Series and Functions	6.1
8	3/11/24	М	Lecture 20	Power Series and Functions	6.1
8	3/12/24	Т	Recitation 15	Review for Exam 2	5.all, 2.4
8	3/13/24	W	Exam 2	Exam 2 - covers 2.4 and Chapter 5	
8	3/14/24	R	Recitation 16	Power Series and Functions	6.1
8	3/15/24	F	Lecture 21	Properties of Power Series	6.2
9	3/18/24	М	Lecture 22	Properties of Power Series	6.2
9	3/19/24	Т	Recitation 17	Properties of Power Series	6.2
9	3/20/24	W	Lecture 23	Taylor and Maclaurin Series	6.3
9	3/21/24	R	Recitation 18	Taylor and Maclaurin Series	6.3
9	3/22/24	F	Lecture 24	Working with Taylor Series	6.4
10	3/25/24	Μ	Lecture 25	Working with Taylor Series	6.4
10	3/26/24	Т	Recitation 19	Working with Taylor Series	6.4
10	3/27/24	W	Lecture 26	Newton's Method	notes
10	3/28/24	R	Recitation 20	Newton's Method	notes
10	3/29/24	F	Lecture 27	Basics of Differential Equations	4.1
11	4/1/24	М	Lecture 28	Direction Fields and Numerical Methods	4.2
11	4/2/24	Т	Recitation 21	Direction Fields and Numerical Methods	4.2
11	4/3/24	W	Lecture 29	Separable Equations	4.3

11	4/4/24	R	Recitation 22	Separable Equations	4.3
11	4/5/24	F	Lecture 30	The Logistic Equation	4.4
12	4/8/24	Μ	Lecture 31	Review of Differential Equations	4.1-4.4
12	4/9/24	Т	Recitation 23	Review for Exam 3	4.1-4.4, 6.all
12	4/10/24	W	Exam 3	Exam 3 - covers sections 4.1-4.4, Chapter 6	
12	4/11/24	R		No Classes - Spring Carnival	
12	4/12/24	F		No Classes - Spring Carnival	
13	4/15/24	Μ	Lecture 32	Parametric Equations	7.1
13	4/16/24	Т	Recitation 24	Parametric Equations	7.1
13	4/17/24	W	Lecture 33	Calculus of Parametric Curves	7.2
13	4/18/24	R	Recitation 25	Calculus of Parametric Curves	7.2
13	4/19/24	F	Lecture 34	Polar Coordinates	7.3
14	4/22/24	Μ	Lecture 35	Area and Arc Length in Polar Coordinates	7.4
14	4/23/24	Т	Recitation 26	Area and Arc Length in Polar Coordinates	7.4
14	4/24/24	W	Lecture 36	Vectors and The Dot Product	notes
14	4/25/24	R	Recitation 27	Vectors and The Dot Product	notes
14	4/26/24	F	Lecture 37	Review for Final Exam	All
15	TBD		Final Exam	Cumulative Final Exam	