

Course Information

Course Number:	Math 147 (Sections 504-505-506)
Course Title:	Calculus I for Biological Sciences
Lecture:	Tuesday/Thursday 11:10-12:25 in Blocker 169
Recitation:	(Sec. 504) Monday/Friday 11:30-12:20 in HEB 203 (Sec. 505) Monday/Friday 01:50 pm-02:40 pm in Blocker 163 (Sec. 506) Monday/Friday 03:00 pm-03:50 pm in Blocker 160
Credit Hours:	4

Instructor Details

Instructor:	Prof. Anne Shiu
Office:	Blocker 601-E
E-Mail:	annejls@tamu.edu
Office Hours:	Thursdays 1:45pm – 3:15 p.m. (First 2 weeks, office hours end at 2:50 p.m.) By appointment (ask one day in advance)

Course Description

Introduction to differential calculus in a context that emphasizes applications in the biological sciences. Topics will include limits, continuity, differentiation and applications, integration, and applications. This course meets twice per week in lecture (TR) and twice per week in recitation (MF). In recitation, students will work on assignments/exercises (activities), discuss homework questions, and complete weekly quizzes.

Course Prerequisites

MATH 150 (or equivalent) or acceptable score on TAMU Math Placement Exam for Math 147/151/171.

Course Schedule (tentative)

https://www.math.tamu.edu/courses/math147/147_weekly_schedule.pdf

Special Course Designation

This is a Core Curriculum course in Mathematics (as approved by the Texas Higher Education Coordinating Board). Courses in this category focus on quantitative literacy in logic, patterns, and relationships. Courses involve the understanding of key mathematical concepts and the application of appropriate quantitative tools to everyday experiences.

Course Learning Outcomes

This course is focused on quantitative literacy in mathematics with an emphasis on real world applications, especially to the biological sciences. Upon successful completion of this course, students will be able to

- Recognize and construct graphs of basic functions, including polynomials, exponentials, logarithms, and trigonometric functions.
- Construct and interpret semilog and double-log plots used to model biological data.
- Evaluate limits of functions graphically and algebraically.
- Evaluate limits of functions analytically by applying the Sandwich Theorem or L'Hopital's Rule.

- Understand the concept of continuity and be able to justify whether a function is continuous or not using the mathematical definition of continuity.
- Explain the Intermediate Value Theorem and use it to estimate roots of functions.
- Compute derivatives using the limit definition of the derivative.
- Interpret derivatives as rates of change and as the slope of a tangent line.
- Compute derivatives of polynomials and rational, trigonometric, exponential, logarithmic, and inverse functions.
- Apply the product rule, quotient rule, and chain rule to take derivatives of compositions of functions.
- Set up and solve related rates problems.
- Compute the linear approximation of a function and use it in applications of approximation and error estimation.
- Analyze first and second derivatives to determine intervals where a function is increasing or decreasing, concave up or concave down, and to find the locations of local extrema and inflection points.
- Graph complicated functions by analyzing and evaluating the information obtained by differentiation.
- Set up and solve optimization problems.
- Evaluate limits of sequences and recursions.
- Model single-species populations and analyze population models.
- Find fixed points and analyze their stability using the cobwebbing method and the stability criterion.
- Interpret the definite integral as a sum of signed areas.
- Compute definite integrals using Riemann sums.
- Find the antiderivatives of basic functions.
- Compute definite integrals using the Fundamental Theorem of Calculus.
- Apply the substitution method to compute integrals.

Core Objectives

Critical Thinking: *creative thinking, innovation, inquiry, and analysis, evaluation and synthesis of information.*

The following critical thinking skills will be assessed on in-class quizzes and exams. Students will:

- Evaluate limits of functions graphically and algebraically.
- Evaluate limits of functions analytically by applying the Sandwich Theorem or L'Hopital's Rule.
- Justify whether a function is continuous or not using the mathematical definition of continuity.
- Compute derivatives using the limit definition of the derivative.
- Compute derivatives of polynomials and rational, trigonometric, exponential, logarithmic, and inverse functions.

- Use inquiry to determine the best method for taking derivatives of complicated functions.
- Apply calculus to find innovative ways to graph complicated functions without the aid of a graphing calculator or computer.
- Think creatively about how to accomplish a given optimization objective and apply calculus to achieve this goal.
- Compute the linear approximation of a function and use it in applications of approximation and error estimation.
- Think creatively about the relationship between two given rates of change and how they affect each other.
- Compute limits of sequences and recursions and synthesize the results by explaining the relationship between these limits and the long-term behavior of population growth.
- Evaluate and synthesize single-species population data to determine the best mathematical model to represent the population.
- Compute definite integrals using Riemann sums.
- Find the antiderivatives of basic functions.
- Compute definite integrals using the Fundamental Theorem of Calculus.
- Apply the substitution method to compute integrals.

Communication Skills: *effective development, interpretation and expression of ideas through written, oral, and visual communication.*

The following communication skills will be assessed in quizzes, exams, and homework. Students will:

- Recognize and construct graphs of basic functions, including polynomials, exponentials, logarithms, and trigonometric functions.
- Construct and interpret semilog and double-log plots used to model biological data.
- Justify results that require the use of theorems such as the Sandwich Theorem and Intermediate Value Theorem or mathematical definitions such as the definition of continuity by writing mathematical proofs.
- Explain the solutions to related rates problems and optimizations problems in writing.
- Develop sketches of the graphs of complicated functions by analyzing the function itself and its first and second derivatives.
- Analyze the stability of fixed points by applying the cobwebbing graphical technique.
- Interpret definite integrals as sums of signed areas under a graph.
- Create a video recording in which they explain a mathematical topic.

Empirical and Quantitative Skills: *manipulation and analysis of numerical data or observable facts resulting in informed conclusions.*

The following empirical and quantitative skills will be assessed via quizzes and exams. Students will:

- Analyze semilog and double-log plots and derive functional relationships associated with such plots.
- Analyze population data and determine whether an exponential discrete time model can be used to model the data.
- Understand the Intermediate Value Theorem and apply it to locate the roots of functions.

- Compute derivatives of functions and use derivatives in applications such as finding equations of tangent lines, computing the linear approximation of a function, solving related rates problems, solving optimization problems, and finding the rate at which a population is growing.
- Find the relationship between two given rates of change and make conclusions about how one is affecting the other.
- Make conclusions about monotonicity, concavity, extrema, and inflection points of a given function by analyzing the given function and its derivatives.
- Manipulate given information to develop a one-variable function to be used in an optimization problem and then apply calculus to find and interpret the optimal solution.
- Use antiderivatives and the Fundamental Theorem of Calculus to compute and interpret areas under curves.

Textbook

Calculus for Biology and Medicine, (4th edition), C. Neuhauser, Pearson. (The textbook is available on reserve at the Evans library annex.)

Websites

<https://people.tamu.edu/~annejls/teaching/147-fall-23.html> (Homework is posted here.)

Also, we will use www.piazza.com.

Calculator Policy.

No calculators are allowed for exams.

Homework

Homework will be due most weeks on **Friday** at the beginning of recitation. *Homework solutions must be clear and well-organized; the grader will impose a 10% penalty for solutions that are lacking in clarity.* Practice/challenge problems are optional and do not count toward your grade. Group work is encouraged, but please write up your solutions independently.

Most homework problems will be typical math problems (show your work and circle your answer). However, on at least one homework, you will be expected to explain your reasoning in a written format (several sentences); and on at least one homework, you will be expected to explain your reasoning in an video recording.

Homework (and some quizzes, exams, etc.) will be submitted via Canvas and then graded using an online grading program (Gradescope). Students will then be able to see their graded work in Canvas/Gradescope.

Late homework policy

Late homework is *not* accepted (except with a University-approved absence; see Make-up Policy below). However, the lowest two homework scores will be dropped.

Quizzes

On many **Mondays**, quizzes will be given, usually covering the material covered on the homework turned in the prior week. The lowest two quiz scores will be dropped.

Exams

- **Exam I** - 1.1-1.3, 3.1-3.5, 4.1 (tentative) Mon.-Tues., Sept. 25-26
- **Exam II-** 4.2-4.8, 5.1 (tentative) Mon.-Tues., Oct. 23-24
- **Exam III** - 5.2-5.6, 2.1-2.3, 6.1 (tentative) Mon.-Tues., Nov. 20-21
- **Final exam** - Comprehensive Thursday, December 7 (3-5pm)

**For each exam, students are required to bring pencils, and have a phone/tablet available at the end of the exam to upload a scanned copy to Canvas/Gradescope.*

Grading Policy

Exam I	-	15%	Final grade: did you accomplish the learning outcomes?
Exam II	-	15%	90%+ A
Exam III	-	15%	80 – 89% B or better <i>(the precise cut-offs will be determined when final grades are assigned)</i>
Final Exam	-	25%	70 – 79% C or better
Recitation*	-	<u>30%</u>	60 – 69% D or better
			< 60% F or better
100%			

**Recitation points come from homework, quizzes, and activities. For each of these three categories, the lowest two scores will be dropped.*

Attendance and Make-Up Policies

Attendance is essential if you wish to complete this course successfully.

- **Excused Absences:** University student rules concerning excused and unexcused absences, as well as makeups, can be found at <http://student-rules.tamu.edu/rule07>. In particular, make-up exams/quizzes or late homework/writing assignments will NOT be allowed unless a University approved reason is given to me in writing. Notification before the absence is required when possible. Otherwise (e.g. accident, or emergency), you must *notify me within two business days* of the missed exam, quiz, or assignment to arrange a makeup.

Learning Support

The Texas A&M **Math Learning Center (MLC)** offers various forms of support for math courses, both online and face-to-face, including drop-in Help Sessions, Tutoring by Appointment, Week-in-Review sessions and other activities. Additionally, the MLC hosts an archive of Supplemental Material, such as Python tutorial videos and recorded review sessions. Find out more at <https://mlc.tamu.edu/>

Use of Generative-AI Technology

According to the Texas A&M University Definitions of Academic Misconduct, **plagiarism** is the appropriation of another person's ideas, processes, results or words without giving appropriate credit (aggiehonor.tamu.edu). *In this course, you must credit your use of anyone else's words, graphic images, or ideas (this mostly applies to homework).* Artificial Intelligence (AI) text generators and natural language processing tools (colloquially, chatbots - such as ChatGPT), audio, computer code, video, and image generators should not be used for any work for this class without explicit permission of the instructor and appropriate attribution (in this case, state what prompt(s) you provided the

AI text generator). However, the use of such tools for simply checking spelling and grammar (without attribution) is acceptable (on homework).

Life

If your performance in the class is negatively affected by your experiences outside of class, please talk to me!

University Policies

Attendance Policy

The university views class attendance and participation as an individual student responsibility. Students are expected to attend class and to complete all assignments.

Please refer to Student Rule 7 in its entirety for information about excused absences, including definitions, and related documentation and timelines.

Makeup Work Policy

Students will be excused from attending class on the day of a graded activity or when attendance contributes to a student's grade, for the reasons stated in Student Rule 7, or other reason deemed appropriate by the instructor.

Please refer to Student Rule 7 in its entirety for information about makeup work, including definitions, and related documentation and timelines.

Absences related to Title IX of the Education Amendments of 1972 may necessitate a period of more than 30 days for make-up work, and the timeframe for make-up work should be agreed upon by the student and instructor" (Student Rule 7, Section 7.4.1).

"The instructor is under no obligation to provide an opportunity for the student to make up work missed because of an unexcused absence" (Student Rule 7, Section 7.4.2).

Students who request an excused absence are expected to uphold the Aggie Honor Code and Student Conduct Code. (See Student Rule 24.)

Academic Integrity Statement and Policy

"An Aggie does not lie, cheat or steal, or tolerate those who do."

"Texas A&M University students are responsible for authenticating all work submitted to an instructor. If asked, students must be able to produce proof that the item submitted is indeed the work of that student. Students must keep appropriate records at all times. The inability to authenticate one's work, should the instructor request it, may be sufficient grounds to initiate an academic misconduct case" (Section 20.1.2.3, Student Rule 20).

You can learn more about the Aggie Honor System Office Rules and Procedures, academic integrity, and your rights and responsibilities at aggiehonor.tamu.edu.

Plagiarism consists of passing off as one's own the ideas, words, writings, etc., which belong to another. In accordance with this definition, *you are committing plagiarism if you copy the work of another person or a solutions manual* and turn it in as your own. Any student found guilty of cheating, plagiarism, or other dishonorable

acts in academic work is subject to disciplinary action. If you are caught cheating, you will receive a grade of “0” and it could result in your failing the course.

Americans with Disabilities Act (ADA) Policy

Texas A&M University is committed to providing equitable access to learning opportunities for all students. If you experience barriers to your education due to a disability or think you may have a disability, please contact Disability Resources in the Student Services Building or at (979) 845-1637 or visit disability.tamu.edu. Disabilities may include, but are not limited to attentional, learning, mental health, sensory, physical, or chronic health conditions. All students are encouraged to discuss their disability related needs with Disability Resources and their instructors as soon as possible.

Title IX and Statement on Limits to Confidentiality

Texas A&M University is committed to fostering a learning environment that is safe and productive for all. University policies and federal and state laws prohibit gender-based discrimination and sexual harassment, including sexual assault, sexual exploitation, domestic violence, dating violence, and stalking.

With the exception of some medical and mental health providers, all university employees (including full and part-time faculty, staff, paid graduate assistants, student workers, etc.) are Mandatory Reporters and must report to the Title IX Office if the employee experiences, observes, or becomes aware of an incident that meets the following conditions (see University Rule 08.01.01.M1):

- The incident is reasonably believed to be discrimination or harassment.
- The incident is alleged to have been committed by or against a person who, at the time of the incident, was (1) a student enrolled at the University or (2) an employee of the University.

Mandatory Reporters must file a report regardless of how the information comes to their attention – including but not limited to face-to-face conversations, a written class assignment or paper, class discussion, email, text, or social media post. Although Mandatory Reporters must file a report, in most instances, you will be able to control how the report is handled, including whether or not to pursue a formal investigation. The University’s goal is to make sure you are aware of the range of options available to you and to ensure access to the resources you need.

Students wishing to discuss concerns in a confidential setting are encouraged to make an appointment with Counseling and Psychological Services (CAPS).

Students can learn more about filing a report, accessing supportive resources, and navigating the Title IX investigation and resolution process on the University’s Title IX webpage.

Statement on Mental Health and Wellness

Texas A&M University recognizes that mental health and wellness are critical factors that influence a student’s academic success and overall wellbeing. Students are encouraged to engage in proper self-care by utilizing the resources and services available from Counseling & Psychological Services (CAPS). Students who need someone to talk to can call the TAMU Helpline (979-845-2700) from 4:00 p.m. to 8:00 a.m. weekdays and 24 hours on weekends. 24-hour emergency help is also available through the National Suicide Prevention Hotline (800-273-8255) or at suicidepreventionlifeline.org.

Copyright Policy:

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