TEXAS A&M UNIVERSITY

Fall 2019
MATH 147: Calculus I for Biological Sciences

Class time and location

- Lecture (all sections): MW 4:10-5:25pm in HELD 113
- Recitation for Section 512: TR 8-8:50am in BLOC 149
- Recitation for Section 513: TR 3:55-4:45pm in CHEN 111
- Recitation for Section 514: TR 5:20-6:10pm in CHEN 111

Learning Outcomes: Upon successful completion of this course, 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.
- Evaluate limits of functions graphically and algebraically.
- Evaluate limits of functions analytically by applying the Sandwich Theorem or L'Hopital's Rule.
- Understand 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.
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- 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

- Students will evaluate limits of functions graphically and algebraically
- Students will evaluate limits of functions analytically by applying the Sandwich Theorem or L'Hopital's Rule.
- Students will justify whether a function is continuous or not using the mathematical definition of continuity.
- Students will compute derivatives using the limit definition of the derivative.
- Students will compute derivatives of polynomials and rational, trigonometric, exponential, logarithmic, and inverse functions.
- Students will use inquiry to determine the best method for taking derivatives of complicated functions.
- Students will apply calculus to find innovative ways to graph complicated functions without the aid of a graphing calculator or computer.

- Students will think creatively about how to accomplish a given optimization objective and apply calculus to achieve this goal.
- Students will compute the linear approximation of a function and use it in applications of approximation and error estimation.
- Students will think creatively about the relationship between two given rates of change and how they affect each other.
- Students will 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.
- Students will evaluate and synthesize single-species population data to determine the best mathematical model to represent the population.
- Students will compute definite integrals using Riemann sums.
- Students will find the antiderivatives of basic functions.
- Students will compute definite integrals using the Fundamental Theorem of Calculus.
- Students will apply the substitution method to compute integrals.

Communication Skills

- Students will recognize and construct graphs of basic functions, including polynomials, exponentials, logarithms, and trigonometric functions.
- Students will construct and interpret semilog and double-log plots used to model biological data.
- Students will 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.
- Students will be required to answer questions during lecture concerning topics discussed in class.
- Students will be required to explain verbally in class the connection between derivatives, rates of change, and slopes of tangent lines.
- Students will explain the solutions to related rates problems and optimizations problems in writing.
- Students will develop sketches of the graphs of complicated functions by analyzing the function itself and its first and second derivatives.
- Students will analyze the stability of fixed points by applying the cobwebbing graphical technique.
- Students will interpret definite integrals as sums of signed areas under a graph.

Empirical and Quantitative Skills

- Students will analyze semilog and double-log plots and derive functional relationships associated with such plots.
- Students will analyze population data and determine whether an exponential discrete time model can be used to model the data.
- Students will understand the Intermediate Value Theorem and apply it to locate the roots of functions.
- Students will 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.
- Students will find the relationship between two given rates of change and make conclusions about how one is affecting the other.
- Students will make conclusions about monotonicity, concavity, extrema, and inflection points of a given function by analyzing the given function and its derivatives.
- Students will 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.
- Students will use antiderivatives and the Fundamental Theorem of Calculus to compute and interpret areas under curves.

Instructor Information

Name	David Manuel
E-Mail Address	dmanuel@email.tamu.edu
Office	Blocker 243D
Office Hours	M 2-3:30pm & W 1-3:30pm no appt needed. Email for other times.
Course Page	http://www.math.tamu.edu/courses/math147
My Webpage	http://www.math.tamu.edu/~dmanuel/math147/
Phone	Math Department: 845-3261 (There is no phone in my office, so email is a better way to reach me)

Required Materials

TEXTBOOK: *Calculus for Biology and Medicine*, by Neuhauser and Roper, 4th edition. (ISBN-13:978-0-13-412259-5)

MyMathLab ACCESS: MyMathLab will be used for homework in this class. In order to use MyMathLab, you must purchase access. For access purchasing information and options, please see my webpage (link at the beginning of the syllabus)

CALCULATOR: A basic (4-function) calculator is allowed on individual quizzes/exams.

TEXAS A&M STUDENT ID: Bring your student ID to each class.

TENTATIVE COURSE TOPICS AND CALENDAR OF ACTIVITIES

Week of	Topic	Sections
26-29 Aug	Lines, Unit Circle, Trigonometry, Exponentials and Logarithms, Exponential Functions, Inverse Functions, Logarithmic Functions, Trigonometric Functions, Graphing	1.2, 1.3
2-5 Sept	Graphing, Emphasis on Semilog and Double-log plots, Limits	1.4, 3.1
9-12 Sept	Continuity, Limits at Infinity, Sandwich Theorem, Trigonometric Limits	3.2, 3.3, 3.4
16-19 Sept	Properties of Continuous Functions, Formal Definition of the Derivative, Properties of the Derivative	3.5, 4.1, 4.2
23-26 Sept	Simple Derivatives, Product & Quotient Rule **Exam 1** (Covering 1.2-1.4, 3.1-3.5, 4.1, 4.2)	4.3, 4.4
30 Sept-3 Oct	The Chain Rule, Derivatives of Trigonometric Functions, Implicit Differentiation	4.5, 4.8, 4.6
7-10 Oct	Related Rates, Higher Derivatives, Derivatives of Exponential Functions	4.6, 4.7, 4.9
14-17 Oct	Derivatives of Inverse Functions, Logarithmic Functions, and the Inverse Tangent Function	4.10, 4.11
21-24 Oct	Extrema and the Mean Value Theorem, Monotonicity, Concavity, Extrema, Inflection Points **Exam 2** (Covering Sections 4.3-4.11)	5.1, 5.2, 5.3
28-31 Oct	Graphing, Optimization	5.6, 5.4
4-7 Nov	L'Hospital's Rule, Exponential Growth and Decay, Sequences, Recurrence Equations (Recursions)	5.5, 2.1, 2.2, 2.3
11-14 Nov	Cobwebbing, Stability, Antiderivatives, The Definite Integral	5.7, 5.10, 6.1
18-21 Nov	The Definite Integral, The Fundamental Theorem of Calculus **Exam 3** (Covering Sections 5.1-5.7, 5.10, 2.1-2.3)	6.1, 6.2
25-26 Nov	The Fundamental Theorem of Calculus, Substitution	6.2, 7.1
2-4 Dec	Substitution and Review	7.1
9 Dec	**Final Exam** (Comprehensive)	

GRADING POLICIES
The course grading will be based on the tables below. At the end of the semester, you will receive the grade you earned according to the scale given. Due to FERPA privacy issues, I cannot discuss grades over email or phone. If you have a question about your grade, please come see me in person.

GRADE BREAKDOWN

Activity	Date	Percentage
Homework	Weekly	7%
Team Recitation Assignments	Weekly	5%
Individual Quizzes	Weekly	8%
Exam I (1.1-1.3, 1.5, 1.6, 2.1-2.4)	Sept 25	20%
Exam II (2.5-2.8, 3.1-3.4, 3.7-3.8)	Oct 23	20%
Exam III (3.9, 4.2, 4.3, 4.6, 4.8, 5.1-5.5)	Nov 20	20%
Final Exam	Dec 9	20%
TOTAL		100%

GRADING SCALE

Range	Grade
$90 \leq$ Avg	A
$80 \leq$ Avg < 90	B
$70 \leq$ Avg < 80	C
$60 \leq$ Avg < 70	D
Avg < 60	F

GRADE APPEAL POLICY: Any question regarding grading must be done at least 30 mimnutes before the next lecture after an assignment is returned to you, or NO change will be made (except for adding mistakes).

HOMEWORK: All graded homework will be done online using MyMathLab. These will be due every Wednesday at 11:55pm (Tuesdays on exam weeks) over the previous week's sections. In addition, suggested homework is posted on the MATH 147 course homepage. These problems are for practice and will not be handed in; however, quiz and exam questions may be similar to suggested homework problems. (NOTE: If you purchase a student solution manual, it is recommended that you do not open it until AFTER you have attempted the question on your own!)

TEAM RECITATION ASSIGNMENTS: Each Tuesday (Thursdays on exam weeks: 13 total) you will have a set of activities in recitation to complete in teams of 3-4 by the end of class. I will be taking the highest 10 scores on these assignments, so missed assignments may only be made up for more than three (excused) absences. In addition, most lectures will have a "Prep Work" page which will be discussed in teams* for 5-10 minutes at the next lecture. These pages may be handed in for up to 0.1% extra credit (per lecture) added on to your FINAL average (maximum 2.5%).
*-all explanations must still reflect individual work. Identical papers will not receive credit, and students found copying other's work or allowing others to copy their work may forfeit ALL extra credit.

QUIZZES: Each Thursday except for exam weeks (11 total) you will have an individual quiz in recitation. I will be taking the highest 9 scores on these quizzes, so missed quizzes may only be made up for more than two (excused) absences.

EXAMS
There will be three in-class exams during the semester. Exams will be given in lecture and consist of part multiple-choice, part workout. You must bring a picture ID (student ID or driver's license) to the exams. More information regarding exams will be given closer to the first exam day. The tentative exam schedule is as follows:

Exam I: Sept 25 Exam II: Oct 23 Exam III: Nov 20

FINAL EXAM
The final exam will be comprehensive and is required for all students. If your final exam grade is higher than your lowest test grade, the grade on your final will replace that test grade in the final grade calculation. The final exam is on Monday, Dec 9 3:30-5:30pm in HELD 113
(You can refer to http://registrar.tamu.edu/Courses,-Registration,-Scheduling/Final-Examination-Schedules for the University final exam schedule)

ATTENDANCE AND MAKE-UP POLICIES
Attendance is essential 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 and quizzes or late homework 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 2 working days** of the missed exam, quiz, or assignment to arrange a makeup. In all cases where an exam/quiz/assignment is missed due to an injury or illness, whether it be more or less than 3 days, **I require a doctor's note**. I will not accept the "University Explanatory Statement for Absence from Class" form. Further, an absence due to a non-acute medical service or appointment (such as a regular checkup) is not an excused absence.
- **Make-up Exams**: If you have a written, University approved excused absence for missing an exam, you will be expected to make-up your exam at the next available opportunity according to the departmental schedule posted at https://www.math.tamu.edu/courses/makeupexams.html. If you do not complete your make-up exam on the following scheduled make-up day, then you must have a University approved excused absence (in writing and in addition to the regular exam day you missed).
  Procedure/Format: When you go to take your make-up exam, you will need to bring your picture ID and pencil. Also, in accordance with University Student Rule 7.3, you MUST notify me in writing (or email) within 2 working days of the original exam you missed if you have a University approved excused absence and want to take a make-up exam. You will be required to provide me with your written documentation for your excused absence.
- **Make-up Quizzes or Team Assignments**: If you have a written, University approved excused absence for missing a quiz or team assignment (beyond the dropped assignments), you will email me to arrange to make up the quiz or assignment as soon as possible with myself (in my office) or your TA (in their office). Students who are unable to attend class for any reason may scan or snap their extra credit Prep Work and email it to me BEFORE the start of class that day to receive credit.

ACADEMIC INTEGRITY

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

Upon accepting admission to Texas A&M University, a student immediately assumes a commitment to uphold the Honor Code, to accept responsibility for learning, and to follow the philosophy and rules of the Honor System. Students will be required to state their commitment on examinations, research papers, and other academic work. Ignorance of the rules does not exclude any member of the TAMU community from the requirements or the processes of the Honor System.

Copying work done by others, either in-class or out-of-class, is an act of scholastic dishonesty and will be prosecuted to the full extent allowed by University policy. Collaboration on individual quizzes or exams, either in-class or out-of-class, is forbidden. If you cheat on an assignment, you will receive a zero. Also, you will be reported to the University. For additional information please visit http://aggiehonor.tamu.edu/.

AMERICANS WITH DISABILITIES ACT:
The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, in Student Services at White Creek, or call 979-845-1637. For additional information visit http://disability.tamu.edu.

If you require accommodations, please see me as soon as possible so that we can make sure you have the necessary paperwork in order. I must have written documentation of the necessary accommodations at least one week before an exam in order to provide accommodations.

TITLE IX AND STATEMENTS ON LIMITS TO CONFIDENTIALITY
Texas A&M University and the College of Science are committed to fostering a learning environment that is safe and productive for all. University policies and federal and state laws provide guidance for achieving such an environment. Although class materials are generally considered confidential pursuant to student record policies and laws, University employees - including instructors - cannot maintain confidentiality when it conflicts with their responsibility to report certain issues that jeopardize the health and safety of our community. As the instructor, I must report (per Texas A&M System Regulation 08.01.01) the following information to other University offices if you share it with me, even if you do not want the disclosed information to be shared:

- Allegations of sexual assault, sexual discrimination, or sexual harassment when they involve TAMU students, faculty, or staff, or third parties visiting campus.

These reports may trigger contact from a campus official who will want to talk with you about the incident that you have shared. In many cases, it will be your decision whether or not you wish to speak with that individual. If you would like to talk about these events in a more confidential setting, you are encouraged to make an appointment with the Student Counseling Service (https://scs.tamu.edu/).

Students and faculty can report non-emergency behavior that causes them to be concerned at `http://tellsomebody.tamu.edu`.

COPYRIGHT POLICY:
All printed materials disseminated in class or on the web are protected by Copy- right laws. One copy (or download from the web) is allowed for personal use. Multiple copies or sale of any of these materials is strictly prohibited.

ADDITIONAL HELP & PREPARING FOR EXAMS
OFFICE HOURS:
As stated on the second page, I have office hours Mondays 2-3:30pm and Wednesdays 1-3:30pm. Use these not only to ask questions you may have about the course content, but also to simply work on homework (on your own or with other students) and ask questions as needed.

RECITATION:
During recitation sessions, you will have opportunities to ask your TA for help on homework problems or reviewing material for quizzes. You will also be able to ask your TA for help on team assignments if (and only if) THE ENTIRE TEAM needs help on a problem (see below).

YOUR CLASSMATES:
During team assignments, the team should be discussing with each other how to solve each problem. Divide-and-conquer is NOT the purpose of these assignments! In addition, take the opportunity to form study groups and GroupMe's to help each other outside of class and recitation.

HELP SESSIONS
Help sessions are an opportunity for you to ask questions and get help with your homework. These sessions are led by students, where you may come and go, as your schedule allows. Once determined, the schedule will be announced in class, posted on our course webpage, and additionally posted at

http://www.math.tamu.edu/courses/helpsessions.html