Math 246 Instructor Syllabus 2021-2022

Text: *Modeling the Dynamics of Life: Calculus and Probability for Life Scientists, 3rd ed, by Frederick Adler* (students may have a custom paperback, abbreviated version of the book)

Calculator: At least a scientific calculator is helpful for getting numerical answers. It is okay for students to use more sophisticated calculators instead, but be careful to have them show their process if so.

Course Goals: A student successfully completing the course should, in a general sense, have…

- ✓ facility with the computation of first and second derivatives and the interpretation thereof,
- ✓ knowledge of the difference between functions on discrete and continuous domains and the practical implications of each,
- ✓ repeated exposure to applications in population, reproduction, drug concentration, vascular function, gas exchange in the lungs, selection, and food intake using all the learning outcomes.

Learning Outcomes: A successful student can…

- ✓ compute and interpret limits at finite values and to infinity,
- ✓ determine the continuity of a function on an interval,
- ✓ determine when it is appropriate to use L'Hospital's Rule and use it in those instances,
- ✓ compute and interpret first and second derivatives for polynomial, logarithmic, exponential, and trigonometric functions,
- ✓ use the limit definition of derivative to set-up and/or determine a derivative by hand,
- ✓ use product, quotient, and chain rules to compute derivatives,
- ✓ use implicit differentiation to solve related rates problems
- ✓ write discrete systems from a description in words,
- ✓ use graphical, numerical, and algebraic means to determine equilibria of discrete systems and classify their stability, find a stability interval, and describe the behavior in words
- ✓ find the solution to basic discrete systems,
- ✓ graph discrete systems and their solutions, including appropriate axis labels
- ✓ find and interpret extrema of continuous and discrete functions,
- ✓ use the Mean Value Theorem, Intermediate Value Theorem, and Extreme Value Theorem to draw conclusions about extrema and roots of continuous functions.

Most importantly, the student can model the mathematical topics described among the learning outcomes in words, then solve or simplify the relevant equations and/or expressions, and finally write a summary statement of the solution.

Additional Notes:

- The course deals with both continuous and discrete functions, something our regular calculus sequence does not. This is the primary way in which the course differs from math 251.
- Students in this course are exclusively human physiology, biology, geological and environmental science majors. The fact that there are applications to biology included in homework and on tests is critical to the success of this course. It's worth letting them know while you aren't a mathematical biologist (or are you?), you are there as a facilitator of mathematical applications that hopefully have relevance for them.
- Consider a hybrid assignment of homework: Some WebWork problems and some hand-in problems. **You can request a paper marker to grade the hand-in work for math 246.** Chapter 2 and the end of chapter 3 have good WebWork questions for students to work on derivatives, but it is helpful to assign biological applications from the textbook as well. In chapter 1, you will need to rely solely on the textbook problems.
- 3.9 is a great section to cover optionally, if there is time.
- Lecture handouts available from Cassandra Fisher by request. (These are modifications of lectures guides by Mike Price)

WEEK	SECTIONS TO COVER	Notes
1	2.1, 2.2, 2.3	**2.1:** Derivative concepts before formal limits is always a little risky **2.2:** Stress the scientific notion of a limit
2	2.4, 2.5, 2.6	
3	2.7, 2.8, 2.9	**2.9:** Chain rule, implicit differentiation & basic related rates

(Winter) *Martin Luther King Jr. Day Monday*

4	2.9, 2.10, 1.5	**1.5:** You can do Chapter 1 first, but that will change the exam schedule *Note: Chapter 1 may be unfamiliar to the typical mathematics instructor. Take the time to familiarize yourself with non-mathematical topics like the function of the lungs and the AV/SA-node communication in the heart; students are more willing to take your subject seriously when you take theirs seriously.* *Review for Midterm, Midterm 1 (All or most of Chapter 2)*
5	1.6, 1.10	I cover 1.10 early to introduce and utilize non-linear DTDS sooner. *Possible demo for drug absorption model (1.6):* I use this to create cobwebbing images for use in class. http://www.math.colostate.edu/_shipman/math155/mathematica/MedicineDTDSP.nbp
6	1.9, 1.11, 3.1	*Possible demo for heart model (1.11):* I use this to create cobwebbing images for use in class. http://www.math.colostate.edu/_shipman/math155/mathematica/HeartModelP.nbp
7	3.1, 3.2, 3.3	**3.3:** This section covers standard optimization, but also from a discrete system perspective *Possible demo for logistic population model (3.2):* I use this to create cobwebbing images for use in class. http://www.math.colostate.edu/_shipman/math155/mathematica/LogisticEquationP.nbp

(Fall) *Veteran's Day, November 11th*

8	3.3, 3.4	**3.4:** Avoid detailed proofs of MVT, IVT, EVT if you can stomach it. The time is better spent on good conceptual understanding of the theorems and how they can be carefully applied. *Review for Midterm, Midterm 2 (Chapter 1 & part of Chapter 3)*
9	3.5, 3.6	

(Fall) *Thanksgiving holiday Thursday/Friday.*

10		This week is most responsibly dedicated to (1) finishing up course content, if necessary and then (2) doing targeted in-class review *Catch-up, review*

(Spring) *Memorial Day holiday Monday*

11 Final exam during scheduled time (https://registrar.uoregon.edu/calendars/final-exam-schedule)

Other Important Dates (http://registrar.uoregon.edu/calendars/academic):

Saturday after 1st week	Last day to drop without a "W"
Monday of 2nd week	Last day to add a class
Sunday after 7th week	Last day to drop or change to P/N --- period!