

Mat 4810: Topics in Elementary and Middle Level Mathematics - Calculus

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1. COURSE CONTENT

Calculus is the study of limiting values and the calculations that can be accomplished by studying the trends in successively better approximations. The methods of calculus have wide-ranging applications in mathematics and science. Calculus can be used to find the rate at which a quantity is changing at any instant, or conversely it can be used to calculate the total quantity at any time if these rates of change are known. Calculus can translate our conceptual understanding of dynamic physical, biological, or social systems into useful mathematical models. Calculus can be used to find optimal solutions to problems, and it can be used to calculate areas and volumes. It is truly one of the monumental achievements of mathematical history!

We will explore calculus and its applications from a variety of perspectives, with an emphasis on conceptual understanding, hands-on modeling, and visualization. Tedious calculation will be kept to a minimum, although some calculation will, of course, be required. We will largely make use of computers to do it, with students expected to use basic software such as spreadsheets. (No previous knowledge of software or computing is needed.)

Text: There is no textbook. A variety of readings, projects, and references will be provided.

2. OBJECTIVES

- (1) The student will be able to accurately discuss and calculate with functions and relations, represent them graphically, and use them to model the relationships among quantities that arise in mathematics, nature, and society.
- (2) The student will be able to evaluate or derive limits of functional values using informal but accurate reasoning.
- (3) In particular, the student will be able evaluate the limits of a variety of infinite sequences, to evaluate the limits of a variety of functions on continuous domains by removing discontinuities, and to derive derivatives and anti-derivatives of a variety of functions using the definitions of these concepts.
- (4) The student will be able to create models of dynamic systems using information about how quantities within them change with respect to time or some other appropriate independent variable.
- (5) The student will be able to calculate with dynamic models to produce graphical and numerical descriptions of their behavior.
- (6) The student will be able to solve a variety of applied problems, including the calculation of areas, volumes, optimal values, and instantaneous velocities, accelerations, and other rates of change.
- (7) As a more general objective, the student will be able to discuss the broad context of an idea and present a comprehensive and coherent overview of that context. The student will be able to recognize and articulate the relationships among different ideas.

3. REQUIREMENTS

Class participation: You are expected to attend every class. Obviously, with a class that meets only once per week for 150 minutes, the material from even one missed class will be very difficult to make up. Furthermore, your participation in class discussion is highly valued.

Homework: Work to be done outside of class will be regularly assigned and graded. This work will be a mixture of problems, essays, and projects.

I encourage you to discuss the course material with your classmates and learn cooperatively. You may hand in joint papers and projects; just give credit to all of the authors or creators. Naturally, all those responsible for a joint assignment will receive the same grade. *You are responsible for learning the material from the homework, so if you do collaborate, be sure you contribute fully and understand all aspects of the assignment. For this reason, collaboration among more than three people is not recommended.*

Exams: It is valuable to be required to produce some work entirely on one's own. Therefore, there will be two midterm exams and a final, which may be partly or entirely given as take-home work. *You are not permitted to collaborate in any way on exams.* The final exam will be comprehensive.

Make-up exams will be given only under extraordinary circumstances or in case of serious emergency; prior permission to miss an exam must be obtained from the professor if at all possible.

4. GRADING

I do not grade on a "curve". Under no circumstances will your grade directly depend on how your fellow students do. If you do a good job of learning the material, you will receive a good grade, regardless of how well the other members of the class perform. Don't forget that the reverse is also true: if you do a poor job of learning the material, you will receive a poor grade, regardless of how poorly everyone else does.

Each requirement will count toward your final grade according to the scheme below (possibly subject to slight modification, but your grade will be no worse than the one obtained this way):

Homework:	35%
Mid-term Exams:	$2 \times 20\% = 40\%$
Final Exam:	25%

Complete honesty on assignments and exams is expected of all students. Any instances of dishonesty will be prosecuted according to university policy.