

Abilene Christian University

Spring 2011



MATH 131.01: Calculus for Applications

MWF: 9:00-9:50

Foster Science Building 239

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Course Blog: blogs.acu.edu/1120_MATH13101

Dr. John Ehrke

Assistant Professor of Mathematics
Office: Foster Science Building 229

Required Text(s): The following text(s) are required for this course and may be purchased in the campus book store, or ordered online at the student's discretion. Please bring these text(s) everyday to class.

1. *Modeling the Dynamics of Life: Calculus and Probability for Life Scientists*, Frederick R. Adler, 2nd edition, Thomson Brooks/Cole, Belmont, CA, 2005.

Course Material(s): The TI-83, TI-84, or TI-84 plus calculators are required for this course. You should bring your calculator everyday to class. Students should have access to a calculator for use on tests, quizzes, and homework. Calculators will not be loaned out during class and cannot be exchanged between students during tests or quizzes.

Course Description: The ACU course catalog describes the course as follows:

MATH 131 Calculus for Applications (3-0-3), Introduction to differential and integral calculus of algebraic, exponential, and logarithmic functions. Emphasis on applications. Not for MATH, MASC, or MATT majors. Prerequisites: MATH 109, 130, or COMPASS placement.

This course will explore how the tools developed in calculus can be applied to various scientific and mathematical contexts. The student who is successful in this course will be able

- to derive models in the life and physical sciences from a mathematical context,
- to use the techniques of calculus—differentiation, integration, optimization—to analyze mathematical models,
- to use numerical techniques and dynamical systems to define and solve problems, and
- to develop geometric visualization and intuition about mathematical processes.

Mission Statement: This course supports ACU's mission statement of preparing students for Christian service and leadership throughout the world by providing students a foundational understanding of the mathematical principles such as problem solving and decision making, as well as exposing students to the role of mathematics in a Christian world view.

Departmental Mission: The mission of the Department of Mathematics is to educate students to be quantitative and analytical thinkers in preparation for Christian service and leadership throughout the world.

Grading Components: This course employs a standard grading scale of, $A = 90 - 100$, $B = 80 - 89$, $C = 70 - 79$, $D = 60 - 69$, $F = 0 - 59$. The specific grading components and associated percentages are described below.

Daily Work (20%): Daily work assignments will consist of homework, quizzes, and small modeling projects assigned over the course of the semester. All work assigned is designed to prepare students for in-class quizzes and exams. Some sort of work will be assigned each class period, and will either be quizzed over in the next class period or turned in for a grade. **Homework will not be accepted late except at the discretion of the instructor and under extraordinary circumstances. In class quizzes cannot be made up.** At the end of the semester, I will drop your three lowest daily grades.

Exams (4 @ 15%) : There will be four exams this semester. Each of the exams is announced in the course schedule included with this syllabus. Each exam will cover material from lectures, assigned homework problems, and quizzes. Each exam is worth 15% of the course grade.

Final Exam (20%): The final exam is scheduled for **2:00 – 3:45 PM, Thursday May 12.** The final exam will be comprehensive and cannot be given early under any circumstance. Please make your end of semester plans accordingly.

Course Competencies: The course competencies, written in student performance terms, are detailed in the table below.

Competency	Measurement Instrument	Measurement Standard
The student will be able to demonstrate an understanding of the mathematical foundations of various physical and biological phenomena.	Exams Homework Quizzes	<ol style="list-style-type: none"> 1. The student will be able to interpret what the solution to a dynamical system implies about the biological or physical context. 2. The student will describe dynamics by quantifying measurements: What is changing? How fast is it changing? What is it changing into? 3. The student will be able to read and interpret models of varying mathematical and scientific complexity. 4. The student will be able to relate the processes of growth and diffusion to dynamical systems and differential equations.
The student will be able to apply the techniques of calculus-differentiation, integration, to various applied problems.	Exams Homework Quizzes	<ol style="list-style-type: none"> 1. The student will be able to communicate how the study of dynamics naturally gives rise to a discussion of the derivative as an instantaneous rate of change. 2. The student will understand the role of the integral in terms of its solution to first order differential equations. 3. The student will apply the fundamental theorems of calculus to representations of functions and understandings of how we reason about functions. 4. The student will apply first and second derivative techniques to optimization problems.

<p>The student will demonstrate geometric visualization and intuition about mathematical processes.</p>	<p>Exams Homework Quizzes</p>	<ol style="list-style-type: none"> 1. The student will be able to describe the relationship between updating functions, cobwebbing, and solutions to dynamical systems. 2. The student will observe bifurcations in parameter studies and produce diagrams to justify conclusions about a model. 3. The student will be able to apply their knowledge of first and second derivatives to properties of curve sketching, and graphical function recognition. 4. The student will understand the geometric significance of the derivative and integral.
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Attendance Policy: Your regular attendance is both necessary and expected. You are responsible for all material covered while absent and will be expected to take regularly scheduled exams at their designated times except under extraordinary circumstances at the discretion of the instructor. You will be notified each time you are absent. Tardiness of more than 15 minutes is considered an absence and will be recorded as such. Should your number of absences exceed 25% of the scheduled course dates you can be dropped from the course at the instructor's discretion. Please make every effort to attend class prepared and ready to participate.

There are some situations for which a student absence will be excused. It is the student's responsibility to document such absences so they are removed from your record. Among the reasons absences are considered excused are the following:

1. Participation in a university sponsored activity. If you miss class for a university sponsored activity, I must have seven (7) days advanced written notice and you must make arrangements to complete your assignments before leaving. The sponsor of the activity is responsible for giving you a signed form on time. If I do not have the appropriate form in advance, the absence will be considered unexcused. This is university policy.
2. Death or major illness in your immediate family. Immediate family includes parents, siblings, grandparents, spouse, child, and other as deemed appropriate by the instructor.
3. Illness of a dependent family member.
4. Injury or illness that is too severe or contagious for you to attend class.
 - a. Injury or illness of three or more consecutive days. For injury or illness that requires you to be absent from classes for three consecutive days, you should obtain a medical confirmation note from your medical provider. A health care professional may provide written confirmation only if he/she is involved in your medical care. The medical confirmation note must contain the date and time of the illness and medical professional's confirmation of needed absence.
 - b. Injury or illness less than three consecutive class days. These will be evaluated on a per case basis at the discretion of the instructor. These must be brought to the instructor's attention through email or written note of explanation within a week of the last date of absence in order to be considered.
 - c. An absence for any other non-acute illness or medical service does not constitute an excused absence.
5. Mandatory admission interviews for professional or graduate schools which cannot be rescheduled. Receiving advising from another department or signing up for classes should never be scheduled during class time and do not constitute an excused absence.

Should an excused absence cause you to miss a test, the instructor will provide an opportunity for the test to be taken at a time that works for all parties involved. If an absence is excused and you miss a daily assignment or quiz, I will replace the grade on the assignment with the average of the previous assignment and the next assignment. This will not require the student to turn in such assignments, but it should be noted that the student is responsible for all material covered during the absence.

Homework Policy: Homework sets will be assigned periodically throughout the semester. It is the expectation of the course that you will be working on homework every day. You should form the habit of doing the relevant problems between successive lectures and not try to do the whole set the night before they are due. Solutions will be available on the afternoon of the day they are due, **so late homework is not acceptable.** I encourage collaboration in this course, but I insist on honesty about it. If you do your homework in a group, be sure it works to your advantage rather than against you. **Good grades for homework you have not thought through will translate to poor grades on exams.** You must turn in your own write-ups of all problems, and, if you do collaborate or use outside resources, you should reference them on your solution sheet. Failure to do so constitutes an act of academic dishonesty.

Make-up Policy: **After an exam has been graded and handed back in class, it will not be accepted for a grade under any circumstance.** In the case of a university excused absence, it is the student's responsibility to make arrangements with the instructor regarding due dates. **Exams cannot be made up if missed except under extraordinary circumstances at the discretion of the instructor.** There will not be any work accepted for extra credit.

Academic Integrity Policy: The university policy regarding academic integrity is available online at <http://www.acu.edu/campusoffices/provost>. Students found guilty of an act of academic dishonesty will be subject to the following disciplinary actions in this course.

First Occurrence: A first violation will result in no credit for that particular assignment (even if it is an exam). No makeup will be allowed. The appropriate campus office(s) will be notified of the incident, and a notice of the incident will accompany your university records.

Second Occurrence: A second violation will result in your withdrawal from the course with a grade of F. A recommendation for suspension from the university will be made by the department.

Electronic Devices Policy: Please turn off all cell phones, beepers, pagers, alarms, .mp3 players, etc... unless such devices are being used for class purposes as indicated by your instructor. Headphones, listening to music, texting, and other uses of these devices not for class purposes are strictly prohibited during class. Frequent disruptions or failure to abide by this policy will be viewed as disruptive behavior and are subject to being dismissed from class and being counted absent. If the disruptions continue you will be dropped from the course.

Disability Accommodations: If you have a documented disability and wish to discuss academic accommodations, please feel free to contact me. The ACU Student Disability Services Office (a part of Alpha Academic Services) facilitates disability accommodations in cooperation with instructors. In order to receive accommodations, you must be registered with Disability Services and you must complete a specific request for each class in which you need accommodations. Contact Disability Services at 674-2667 for further information or to set up an appointment.

Office Hours, Spring Schedule: Below is my schedule for the spring 2011 semester. The times marked “Office Hours” represent the times I will make myself available to work with you on homework, understanding lectures, or for any other questions you might have. Please take advantage of these opportunities. If you find that none of these times work for you, feel free to email me at jee99a@acu.edu or call me at 674-2162 to set up an alternate appointment. No appointment is needed if you attend regularly scheduled office hours. This schedule is posted on the front of my office door as well.

Spring 2010	Monday	Tuesday	Wednesday	Thursday	Friday
8:00 – 8:30					
8:30 – 9:00					
9:00 – 9:30	MATH 131.01 FSB 239	Office Hours	MATH 131.01 FSB 239	Office Hours	MATH 131.01 FSB 239
9:30 – 10:00	MATH 131.01 FSB 239	Office Hours	MATH 131.01 FSB 239	Office Hours	MATH 131.01 FSB 239
10:00 – 10:30	MATH 361.01 FSB 239	Office Hours	MATH 361.01 FSB 239	Office Hours	MATH 361.01 FSB 239
10:30 – 11:00	MATH 361.01 FSB 239	Office Hours	MATH 361.01 FSB 239	Office Hours	MATH 361.01 FSB 239
11:00 – 11:30	Lunch				
11:30 – 12:00					
12:00 – 12:30					
12:30 – 1:00					
1:00 – 1:30	MATH 124.03 FSB 205		MATH 124.03 FSB 205		MATH 124.03 FSB 205
1:30 – 2:00	MATH 124.03 FSB 205		MATH 124.03 FSB 205		MATH 124.03 FSB 205
2:00 – 2:30	Office Hours		Office Hours		
2:30 – 3:00	Office Hours		Office Hours		
3:00 – 3:30	Office Hours		Office Hours		
3:30 – 4:00					
4:00 – 4:30					
4:30 – 5:00					

Course Schedule: A tentative course schedule for the semester is detailed in the table below.

Week 1	Jan 19	Discrete-time dynamical systems (1.5)
	Jan 21	Analysis of discrete-time dynamical systems (1.6)
Week 2	Jan 24	Analysis of discrete-time dynamical systems cont. (1.6)
	Jan 26	Populations modeled by exponentials and logarithms (1.7)
	Jan 28	A model of gas-exchange in the lung (1.9)
Week 3	Jan 31	An example of nonlinear dynamics (1.10)
	Feb 2	Applications to excitable systems: the heart (1.11)
	Feb 4	Introduction to derivatives, rates of change (2.1)
Week 4	Feb 7	Review
	Feb 9	Test 1 (Chapter 1)
	Feb 11	Limits and continuity (2.2-2.3)
Week 5	Feb 14	Derivatives rules for polynomials (2.4-2.5)
	Feb 16	Derivatives of products and quotients (2.6)
	Feb 18	Derivatives of exponential and logarithms (2.8)
Week 6	Feb 21	Chain Rule (2.9)
	Feb 23	Second derivatives (2.7)
	Feb 25	Curve sketching
Week 7	Feb 28	Review
	Mar 2	Test 2 (Chapter 2)
	Mar 4	Stability and the derivative (3.1)
Week 8	Mar 7	More complicated dynamics (3.2)
	Mar 9	Optimization (3.3)
	Mar 11	Optimization (3.3)
Spring Break	Mar 14	Spring Break – no class
	Mar 16	Spring Break – no class
	Mar 18	Spring Break – no class
Week 9	Mar 21	Three important theorems: IVT, EVT, MVT (3.4)
	Mar 23	Infinity and limits (3.5)
	Mar 25	L'Hopital's Rule (3.6)
Week 10	Mar 28	Linear and quadratic approximations (3.7)
	Mar 30	Newton's method (3.8)
	Apr 1	Review

Week 11	Apr 4	Test 3 (Chapter 3)
	Apr 6	Differential Equations (4.1)
	Apr 8	Integrals as solutions to differential equations (4.2)
Week 12	Apr 11	Integration techniques (4.3)
	Apr 13	Integrals and sums (4.4)
	Apr 15	Definite integrals (4.5)
Week 13	Apr 18	The first and second fundamental theorems (4.5)
	Apr 20	Where do functions come from?
	Apr 22	Easter Holiday – no class
Week 14	Apr 25	More applications of integrals (4.6)
	Apr 27	Improper integrals (4.7)
	Apr 29	Diffusion across a membrane (5.1)
Week 15	May 2	Review
	May 4	Test 4 (Chapter 4)
	May 6	Review