

Essentials

- Math 431, Dynamical systems
SDSMT, Fall 2008, 3 credits
- Meets Monday, Wednesday, and Friday from 1:00–1:50 PM in McLaury 213.
- The course text is *An Introduction to Dynamical Systems* (second edition), by R. Clark Robinson. We will cover Chapters 1–7, with additional material as time permits.
- A tentative course outline can be found on the class webpage.

Instructor information

- Dr. Travis Kowalski (either “Travis” or “Dr. K” is fine)
- Office: McLaury 314D
Phone: (605) 394-6146
Email: travis.kowalski@sdsmt.edu
- Webpage: <http://www.mcs.sdsmt.edu/tkowalsk/>
We will be using Desire2Learn; visit <https://d2l.sdbor.edu> for more information.
- Office hours: See the webpage above for tentative office hours. Of course, you can always make an appointment with me; just contact me before or after class.

Course objective and description. The course will introduce the subject of dynamical systems and will survey some of the basic concepts. Some topics will be treated in detail, where others will be described and references given for further study. *Dynamical Systems* is the study of systems which are functions of time; they arise in many application areas within physics, electrical and mechanical engineering, chemistry, biology and more. Models of real world phenomenon often include a temporal aspect and are thus dynamical systems. This course will introduce the core set of tools to study the models and derive physically relevant conclusions. The first part of the course will focus on continuous time dynamical systems and use ordinary differential equations as the main set of examples. The latter part of the course will investigate discrete time dynamical systems.

Minimum prerequisite. Calculus, Differential Equations, and Linear Algebra; each completed with a C or better.

Technology. Many aspects of dynamical systems lend themselves to empirical or numerical investigation, or involve complicated 2- and 3-dimensional geometric sets. Hence, I will make frequent in-class use of Maple, a powerful “computer algebra system” to which you have access from any school computer. Moreover, you will get some first-hand Maple experience with occasional lab assignments designed to bolster intuition or real-world applicability.

Grading. The grading is based on the following:

Assignments: 200 points
3 Examinations: 100 points each
Final exam: 50 points

The final is on **Tuesday, December 16, from 11:00–12:50 AM**. This is non-negotiable.

Letter grades will be assigned according to the following scale:

A: 630-700 points
B: 560-629 points
C: 490-559 points
D: 420-489 points
F: less than 420 points

Plus or minus grades are not allowed (Board of Regents policy, Fall 2003). I reserve the right to *lower* these values as I see fit.

Instruction and attendance. Class will mostly take the form of lecture and discussion. However, we will occasionally have group activities, computer labs, or other meetings as need be. Hence, daily attendance is expected, although I will not police it. You should bring your book to every class period and be prepared by reading the corresponding text material before the coverage of the material in class (and it is likely you will need to read the same material after class). It is expected that you should spend around 2 hours of study for every hour in class.

However, when you attend class, be sure you are on-time and ready to participate for the duration of class. I work hard at making class useful and informative for you, and will strive to make the study of dynamical systems, if not fun exactly, then at least engaging. Arriving to class late or attempting to pack up early are extremely disrespectful behaviors, both towards the instructor and to other students, and I have little patience for either. Further details about classroom behavior are outlined below.

Assignments. The only way to *learn* mathematics is to *do* mathematics. As a result, I will challenge you with frequent assignments, in class and out, to help you develop skill and proficiency with the subject. Assignments will come in three flavors:

- *Homework.* I will assign homework problems for you to work on every day in class, which I expect you to work on in a dedicated “homework notebook.” These problems will give you the best training in the mechanical aspects of the course, and are one of the ways I can gauge how much effort you are putting into the course. Of these, I will collect a portion from time to time.
- *Quizzes.* Because part of the material of this course is mechanical in nature, expect to have relatively frequent “short quizzes,” which will test mastery of basic mechanical skills and prepare you for the exams. I will drop your lowest quiz grade.
- *Projects.* During the semester we will have the occasional computer lab, designed specifically to give you exposure to working with the concepts from class in cooperative group settings and dealing with more real-world based applications. These projects will be announced in class well ahead of their due dates.

Late homework assignments or projects will be penalized by a 50% reduction of points for each day it is late.

Examinations and make-up policy. There will be three hour-long examinations over the semester that will test your mastery of the course material. These will not be comprehensive, and will test both mechanical facility (problems resembling the assigned homework) and original synthesis (problems involving novel ideas). Exams will be announced at least one week ahead of time. For any conflict with a scheduled exam time that is known in advance, the student is obligated to notify the instructor in advance; I will most likely be happy to give you a make-up exam. Exams that are missed with no prior notification or for unexcused reasons will earn a score of 0 and no make-up will be allowed. Notification may be made via email or phoning me, but be sure I contact you back!

Final exam. The final exam, as per tradition in Math 431, is comprehensive. (Sorry.) The final is on Tuesday, December 16, from 11:00–12:50 AM. **This is not negotiable.**

Course outcomes. A student who successfully completes this course should, *at a minimum*, be able to:

1. Solve systems of linear ordinary differential equations
2. Model physical systems using ordinary differential equations
3. Apply the existence and uniqueness theorems for ordinary differential equations
4. Step through a numerical method for solving ordinary differential equations
5. Generate a phase portrait for a nonlinear system
6. Perform a linear stability analysis for a nonlinear system
7. Construct Lyapunov functions for dissipative systems
8. Describe periodic orbits for a given nonlinear system
9. Locate and describe bifurcation points for the system
10. Compute Lyapunov exponents
11. Test for chaotic attractors

Special needs. Students with special needs or requiring special accommodations should contact me and/or the campus ADA coordinator, Dr. Jolie McCoy, at 394-1924 at the earliest opportunity.

Most of these policies are common sense and are associated with being a responsible adult at an institution of higher learning.

Classroom behavior. The Student Handbook prohibits the disruption or obstruction of teaching. Activities that are disruptive and/or obstructive to teaching will include, but are not limited to, the following:

- *Showing up late to class.* While it is understandable that you might be a few minutes late to class there is a limit to how late one can be. As a general rule, it is acceptable for a person that is less than 5 minutes late to enter class. I ask that if you are more than 5 minutes late to class to refrain from entering class. You can always catch me after class if they need to see me.
- *Eating in class.* Your schedule may have classes that overlap your lunch hour, or don't leave you time to eat during the day. Nevertheless, refrain from eating during class. Those with medical conditions that require special accommodations are certainly welcome to speak with me.
- *Electronic disruptions.* The use of cell phones, pagers, PDAs, non-SDSMT laptop computers, or any other associated electronics in class is prohibited. The best advice is to simply leave your electronic noisemakers at home or in your car. However, if there is some compelling reason why you require such a device then make sure your device is (at the very least) set to vibrate or (preferably) turned off. If an electronic device disrupts class then the owner will sacrifice their highest quiz score for each offense, or pay **The Fine**. The Fine is the purchase of cookies, donuts, or other snacks for the entire class. This happens to be similar to a policy used at the state legislature.

Email etiquette. I am more than happy to take questions or suggestions by email, and email is one of the best ways to contact me. However, keep in mind the following. (1) If you are writing about issues relating to the class, please use your *D2L email account* rather than campus mail; doing so ensures that I will respond to you in some fashion within 24 hours. (2) I am your professor, not your BFF LOL ZOMG!!! Emails written without a salutation, reasonable grammar, and respectful tone of voice will be promptly ignored.

Academic dishonesty. If you cheat on a test or assignment, you *will* receive a 0 on the work, and you *may* fail the course out right. Discussing a problem with other students is a valuable learning tool; copying someone else's work is not. All students will be held to the institutional standard for academic honesty and integrity. The following are the relevant sections taken from the student handbook (SD BOR policy), which states that acts of academic dishonesty will include, but are not limited to, the following:

- *Cheating*, which is defined as, but not limited to, the following: (1) the use or giving of any unauthorized assistance in taking quizzes, tests, or examinations; (2) the use of sources beyond those authorized by the instructor in writing papers, preparing reports, solving problems, or carrying out other assignments; or (3) the acquisition, without permission, of tests or other academic material belonging to a member of the institutional faculty or staff.
- *Plagiarism*, which is defined as, but is not limited to, the following: (1) the use, by paraphrase or direct quotation, of the published or unpublished work of another person without full and clear acknowledgement consistent with accepted practices of the discipline; (2) the unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials.
- *Dishonesty* relating to academic achievement, research results or academically related public service.
- *Furnishing false information* to any institutional official, faculty member or office.
- *Forgery, fabrication, alteration, misrepresentation or misuse* of any document, record, or instrument of identification, including misrepresentations of degrees awarded or honors received.

State Policy on "Freedom in Learning." Students are responsible for learning the content of any course of study in which they are enrolled. Under Board of Regents and University policy, student academic performance shall be evaluated solely on an academic basis and students should be free to take reasoned exception to the data or views offered in any course of study. Students who believe that an academic evaluation is unrelated to academic standards but is related instead to judgment of their personal opinion or conduct should contact the dean of the college which offers the class to initiate a review of the evaluation.

Official policies. You can read the official Board of Regents student policies at

- http://www.sdbor.edu/policy/3-Student_Affairs/documents/3-4.pdf.