# M 454 INTRODUCTION TO DYNAMICAL SYSTEMS I

**Time** TTH 9:25-10:40 AM in Wilson 1-144
**Instructor:** Tomas Gedeon

**Office Hours:** MF 10-11:30 at Webex link https://montana.webex.com/meet/r58j431 Other times by appointment.
**Contact:** gedeon@math.montana.edu

**Textbook:** Steven Strogatz, Nonlinear Dynamics and Chaos, 2nd edition.

**Grading:** We will have 2 exams and a cumulative final exam. The exams will be after chapters 4 and 7. Exams will be each worth 50 pts, while the final will be worth 100 pts.

I will also assign a few problems per week. I will then grade a randomly selected problem from the set. Each of these problems will be worth 10 pts. These problems will be assigned a week before they are due

**Blended class format** The class will be split between working independently online for basic content and classroom hours to explore more advance topics. You will be attending face-to-face classes one day a week. You will be assigned to a group that will either be in class either on Tuesdays or on Thursdays. Check D2L for your assignment to a group. We have 30 students in the class, 15 in each group and there are 15 seats in the class, so there is no room for you to come in with the other group. It will be the same days of the week for the entire semester. You will be responsible for viewing content videos before attending the face-to-face classes. The links for the videos and skeleton notes will be posted in D2L (Brightspace) under Content.

During the first week, I will provide the intro to the class and lecture on both days on different material from chapter 1. I will record these sessions and post them for the other group. Starting from Week 2, the classroom time will be devoted to questions and working on problems. It will be the same session in Tuesday and Thursday and will not be recorded. If this does not work and there is too many questions to answer during one 1:15 hour session, we will go back to recording, not repeating the sessions, and recording them. Then you will be responsible to watch the recording of the other session online.

**Work and attendance** Keeping up with the material and attendance are important. You are expected to be prepared for class by watching the relevant videos before your class time. You are also expected to attend every class assigned to your group, and participate in classroom discussions. However, please evaluate your own health status regularly and refrain from attending class and other on-campus events if you are ill. MSU students who miss class due to illness will be given opportunities to access course materials online. You

are encouraged to seek appropriate medical attention for treatment of illness. In the event of contagious illness, please do not come to class or to campus to turn in work. Instead notify me by email about your absence as soon as practical, so that accommodations can be made.

**Material:** We will try to cover the first eight chapter in the book and also introduce concept of chaos from chapter 9. In addition to 50 videos that I recorded and which may be of less than professional quality if you remember my atrocious handwriting, the book is well written, interesting and I hope you will enjoy it. But this class will also require that you will put some work into combining many things that you have learned already in different classes with many new ideas and concepts.

**Learning outcomes**
Upon completion of this course, a student will be able to:

- Provide a qualitative bifurcation analysis of a simple one-dimensional, one parameter nonlinear differential equation;
- Understand and analyze basic types of linear and nonlinear oscillators;
- Linearize a two-dimensional non-linear system of differential equations at an equilibrium, and use this linearization to analyze the behavior of nearby solutions;
- Analyze dynamics of a two-dimensional nonlinear system of differential equations using a phase plane analysis.

## 1. Masks in the classrooms

1.1. **Wearing masks in classrooms is required.** Face coverings are required in all indoor spaces and all enclosed or partially enclosed outdoor spaces. MSU requires all students to wear face masks or cloth face coverings in classrooms, laboratories and other similar spaces where in-person instruction occurs. Your mask should cover your nose to the bottom of your chin. MSU requires the wearing of masks in physical classrooms to help mitigate the transmission of SARS-CoV-2, which causes COVID-19. The MSU community views the adoption of these practices as a mark of good citizenship and respectful care of fellow classmates, faculty, and staff. The complete details about MSU's mask requirement can be found at: https://www.montana.edu/health/coronavirus/index.html.

1.2. **Accommodations for not wearing a mask.** Individuals whose unique and individual circumstances require an exception to the face covering requirement, as indicated by a medical professional, may request one in accordance with the campus ADA policies. Students should contact the Office of Disability Services at 994-2824 or drv@montana.edu to receive written permission from the Office of Disability Services at MSU. It is strongly recommended that students make contact prior to arriving on campus in order to provide adequate time for their request to be evaluated.

## 2. Student conduct.

2.1. **Behavioral expectations.** Montana State University expects all students to conduct themselves as honest, responsible and law-abiding members of the academic community and to respect the rights of other students, members of the faculty and staff and the public to use, enjoy and participate in the University programs and facilities. For additional information reference see `http://www2.montana.edu/policy/student_conduct/student_conduct-code_2008-2009.htm`

2.2. **Collaboration.** University policy states that, unless otherwise specified, students may not collaborate on graded material. Any exceptions to this policy will be stated explicitly for individual assignments. If you have any questions about the limits of collaboration, you are expected to ask for clarification.

**In this class, I encourage collaborative development of ideas, since that mimics collaborative spirit and practice of mathematics. However, the written (and thus graded) homework should be exclusively your own work and written without any help from your colleagues or their written work. Many of you may take a comprehensive exam in Topology and at that point it will be your knowledge that will be important.**

2.3. **Plagiarism.** Paraphrasing or quoting anotherÕs work without citing the source is a form of academic misconduct. Even inadvertent or unintentional misuse or appropriation of another's work (such as relying heavily on source material that is not expressly acknowledged) is considered plagiarism. If you have any questions about using and citing sources, you are expected to ask for clarification. Academic Misconduct Section 420 of the Student Conduct Code describes academic misconduct as including but not limited to plagiarism, cheating, multiple submissions, or facilitating othersÕ misconduct. Possible sanctions for academic misconduct range from an oral reprimand to expulsion from the university.

2.4. **Academic Expectations.** Section 310.00 in the MSU Conduct Guidelines states that students must:

- **A.:** be prompt and regular in attending classes;
- **B.:** be well prepared for classes;
- **C.:** submit required assignments in a timely manner;
- **D.:** take exams when scheduled;
- **E.:** act in a respectful manner toward other students and the instructor and in a way that does not detract from the learning experience; and
- **F.:** make and keep appointments when necessary to meet with the instructor. In addition to the above items, students are expected to meet any additional course and behavioral standards as defined by the instructor.

2.5. **Withdrawal Deadlines.** After Nov. 16th, I will only support requests to withdraw from this course with a ÒWÓ grade if extraordinary personal circumstances exist.

2.6. **Students with Disabilities.** If you have a documented disability for which you are or may be requesting an accommodation(s), you are encouraged to contact your instructor and Disabled Student Services as soon as possible.

2.7. **Student Educational Records.** All records related to this course are confidential and will not be shared with anyone, including parents, without a signed, written release. If you wish to have information from your records shared with others, you must provide written request/authorization to the office/department. Before giving such authorization, you should understand the purpose of the release and to whom and for how long the information is authorized for release.