Advanced Differential Equations (Dynamical Systems) I, II, and III
MTH 621/2/3, 2020-2021.

Professor: J. J. P. Veerman
Class meets: TR 17:15 - 18:30 (via zoom).
Office: 464B FMH (503-725-8187)
Office Hours: TR 18:30 - 18:55, or by appointment.
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Text: 1) S. Sternberg, *Dynamical Systems*, Dover Publications, revised edn, 2013, New York. ISBN-13: 978-0486477053-03.
2) Additional materials will be provided for by instructor.

General Description: This is an advanced course in advanced differential equations and their applications. This year we will concentrate on dynamical systems. Rather than a giving a general theory, we will discuss examples from all branches of mathematics and the sciences. We start with a discussion of the simplest nonlinear map from the interval to itself, and show how it leads to very complex behavior, including period-doubling and chaos. We will discuss complex dynamics (Mandelbrot and Julia sets). We will discuss examples of chaotic attractors in low dimensional maps (such as the Smale horsehoe and the Lorenz attractor). Subsequently, we will look in more detail at attractors and their properties such as dimension. The study of the Perron Frobenius theorem will permit us to study random walks on graphs, Google's pagerank algorithm, and other network dynamics. We then turn to the Poincare-Bendixson theorem, which in turn will lead us to look at dynamical systems studied in biological evolution.

The last term of this sequence will be run as a topics course. There may also be the possibility of doing small projects counting towards a final grade. Subjects such as applications of number theory in dynamical systems, ergodic theory, complex dynamics, fractal dimension, evolutionary dynamics, network dynamics, population dynamics, and many others can be considered.

Background: These courses form a sequence of three: Mth 621, Mth 622, and Mth 623 which must be taken in sequence. Expected preparation: Mth 423/Mth 523 or Mth 472/Mth 572.

Grading: Your course grade will be based on some of the assigned homeworks. If necessary, there may also be in-class exams and/or quizzes.

Homeworks will be assigned, and the exams/midterms (if any) will be based on the theory discussed in class as well as on the assigned homeworks. In homeworks and projects, collaboration is allowed and encouraged. Plagiarism, however, is not tolerated. You must turn in original work.

All answers on any work you turn in (home works, quizzes, or exams) must be justified, even if that is not evident from the phrasing of the question. Answers without justification will receive partial credit at best. Before turning in exams or home works, write your first plus last name in the top right corner of each sheet you turn in (even if you staple them together)!

Attendance: You are expected to attend classes. Home works, changes to this syllabus or to the scheduling of exams will be announced in class. If you have to miss class, it is your responsibility to find out what happened in class *from your classmates.*

Homework: As material is covered in class, a list of accompanying homework will be assigned. Reading the text and completing the homework is essential to your success in this course, and it will likely require a substantial amount of time and effort on your part to complete it successfully. You may find it helpful to form a study group with 2-5 other students and work together outside of class on the assignments. However, each student must write up and submit his or her own work. Plagiarism from either the web, your colleagues, or any other source is unacceptable at Portland State, and cases may be referred to the Dean Students for action. Homework (if due) must be turned in on

the due date *at the beginning* of the class. ***HW 10 minutes late or more will not be accepted, except in cases governed by university guidelines (illness, etc).***

Exams: If given, exams or quizzes are cumulative and will cover all assigned exercises and theory. Dates and times for finals are set by the University.

Access and Inclusion for Students with Disabilities: PSU values diversity and inclusion; My goal is to create a learning environment that is accessible, equitable,, inclusive, and welcoming. I am committed to fostering mutual respect and full participation for all students. If any aspects of instruction or course design result in barriers to your inclusion or learning, please notify me. Additionally, the Disability Resource Center (DRC) provides reasonable accommodations for students who encounter barriers in the learning environment. The DRC works with students who have physical, learning, cognitive, mental health, sensory, and other disabilities.

If you have, or think you may have, a disability that may affect your work in this class and feel you need accommodations, contact the Disability Resource Center to schedule an appointment and initiate a conversation about reasonable accommodations.

If you already have accommodations, please contact me to make sure that I have received your faculty notification letter from the DRC so we can discuss your accommodations.

The DRC is located in 116 Smith Memorial Student Union, Suite 116. You can also contact the DRC at 503-725-4150 or, drc@pdx.edu. Visit the DRC online at https://www.pdx.edu/disability-resource-center.

Title IX Reporting Obligations:
As an instructor, one of my responsibilities is to help create a safe learning environment for my students and for the campus as a whole. Please be aware that as a faculty member, I have the responsibility to report any instances of sexual harassment, sexual violence and/or other forms of prohibited discrimination. If you would rather share information about sexual harassment, sexual violence or discrimination to a confidential employee who does not have this reporting responsibility, you can find a list of those individuals or contact a confidential advocate at 503-725-5672. For more information about Title IX please complete the required student module Creating a Safe Campus in your D2L.