Math 331   Ordinary Differential Equations   Winter 2022

Instructor	Amites Sarkar
Text	Differential Equations: From Calculus to Dynamical Systems Virginia W. Noonburg
Calculator	TI-89 recommended

Course content

This is a first course in ordinary differential equations. (Partial differential equations are the subject of another course.) The main topics are the quantitative and qualitative analysis of some ordinary differential equations (ODEs), and some systems of ODEs. We'll study both the underlying theory, as well as the use of ODEs in modeling processes from physics and biology (and chemistry, if time allows).

In terms of the book, we'll cover most of Chapters 1–4, as well as Sections 5.1 and 5.2.

Exams

Midterm 1	Friday 21 January
Midterm 2	Friday 11 February
Midterm 3	Friday 4 March
Final	Monday 14 March 1–3 pm

Grading

The midterms are each worth 20%, and the final is worth 40%. If you feel too ill to take an exam, don't take it, but bring a doctor's certificate to me when you feel better and I will make arrangements.

Office hours

My office hours are 2–2:50 on Mondays, Tuesdays, Thursdays and Fridays, in 216 Bond Hall. My phone number is 650 7569 and my e-mail is amites.sarkar@wwu.edu

Relation to Overall Program Goals

Among other things, this course will (i) enhance your problem-solving skills; (ii) help you recognize that a problem can have different useful representations (graphical, numerical, or symbolic); (iii) increase your appreciation of the role of mathematics in the sciences and the real world.

Course Objectives

The successful student will demonstrate:

1. The ability to set up an initial value problem for a differential equation or system that models a given dynamical process, and, when it is possible to solve the problem, the ability to interpret the solution in the context of the original problem.

2. The ability to recognize separable differential equations, find their general solutions, and use the general solution to solve initial value problems.

3. The ability to recognize linear first-order differential equations, solve them using the method of integrating factors, and solve related initial value problems.

4. The ability to sketch and read slope fields of first-order equations, and use them to qualitatively describe solutions.

5. For autonomous first-order equations; the ability to construct the phase line, find and classify equilibrium solutions, and to use the phase line to qualitatively describe solutions.

6. Understanding of the statement and the implications of the existence and uniqueness theorems.

7. The ability to find bifurcation values and construct and interpret bifurcation diagrams for autonomous first-order equations that depend on a parameter, and an understanding of how a small change in the parameter value can affect the qualitative behavior of solutions.

8. The ability to convert a higher-order system into a first-order system.

9. The ability to produce and interpret direction fields and phase portraits for systems of autonomous equations, the ability to use them to analyze the qualitative behavior of solutions to the system, and an understanding of the relationship between solution curves in the phase plane, solutions of the system, and the solution's component curves. The ability to find equilibrium solutions of such systems.

10. The ability to find the general solution of any 2×2 linear system with constant coefficients, solve initial value problems for such systems, classify the equilibrium solutions, and describe the qualitative behavior of solutions by analyzing the phase portrait.

11. Understanding of the trace-determinant plane as a graphical summary of the possible qualitative behaviors for 2×2 linear systems with constant coefficients, and the ability to use it to analyze such systems that depend on a parameter.

12. The ability to find the general solution of second-order homogeneous linear equations with constant coefficients, solve related initial value problems, describe the behavior of the solutions, and understand the use of such equations to model oscillatory behavior.