

# MATH 345: DIFFERENTIAL EQUATIONS

## SECTION 001

SYLLABUS – SPRING, 2024

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<b>Instructor:</b>	Mayla Boguslav (Dr. B)
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<b>Class Times:</b>	Monday, Wednesday, Friday, 12:00 to 12:50 PM, Engineering E 206 Tuesday, 12:00 to 12:50 PM, Weber 205
<b>Office Hours:</b>	Thursday, 11:30 AM to 1:30 PM
<b>Prerequisites:</b>	MATH 229 (Matrices and Linear Equations), MATH 369 (Linear Algebra I), or DSCI 369 (Linear Algebra for Data Science) MATH 255 (Calc. for Biological Scientists II) or MATH 261 (Calc. for Physical Scientists III)

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### Course Description:

This course covers ordinary differential equations, which arise in the study of many areas of science or engineering. When modeling the world mathematically, the results are often differential equations that describe how the system being modeled behaves. The course is structured as follows:

- (1) We introduce differential equations and describe the theory of solving first-order equations. We describe numerical methods such as Euler's method and Runge-Kutta methods for finding approximate solutions, and review a number of applications of first-order equations.
- (2) We introduce linear second-order equations, and present several solution techniques including the methods of undetermined coefficients and variation of parameters. We present several applications of such equations, and describe how series can be used to find solutions, including the method of Frobenius.
- (3) We define and use the Laplace transform and its inverse, and use these transforms, along with convolution techniques to solve equations.
- (4) We briefly explore higher-order equations, extending the methods of undetermined coefficients and variation of parameters.
- (5) We finish by examining how to apply eigenvalue techniques from linear algebra to solve systems of linear differential equations.

### Textbook:

The textbook is **Elementary Differential Equations with Boundary Value Problems, by William F. Trench** (Brooks/Cole, 2001, ISBN 978-0534263287). A free PDF download of this textbook is available here:

<http://ramanujan.math.trinity.edu/wtrench/texts/index.shtml>

This web site shows two versions, the second has "with Boundary Value Problems" added to the title - we want this version. If you prefer a physical textbook, they can be ordered from a number of online retailers. Either the PDF or the hardcover book is fine for this course.

### Class Meetings, Homework, Labs, Exams:

Class meets four days a week. Monday, Wednesday, and Friday are regular class days. Tuesday is lab day, focused on applications, problem solving, group work, or the semester project.

There will be 14 homework sets, due on **Mondays**. Homework should be turned in individually, but feel free to work together (please write the names of all who worked together). Instead of the traditional midterm exams, there will be weekly quizzes on **Mondays**. Each quiz will cover the prior week's material, and will take up about 20 minutes of class time. Quizzes are open-note and open-book.

There will be a semester long group project to model a real world system of each groups choosing. During lab time, we will form groups, discuss example projects, discuss the modeling process, and have time to work on the projects. There will be 3 assignments throughout the semester that will culminate in a final written report and

presentation due at the end of the semester.

There will be a **Final Exam** held during finals week. Based on our class meeting time, the Final Exam will be Wednesday of finals week (May 8), from 7:30 - 9:30 AM. The Final Exam will cover all material in the course. The final will consist of a few differential equations to solve, and some general, conceptual questions about the course content. The final exam will also be open-note and open-book.

### **Grading:**

Grades will reflect my best assessment of your understanding of the concepts and techniques in the course. They will be based on homework, quizzes, the group project, and the final exam. Homework and quizzes will be graded together: I will choose 2-3 problems from the homework to grade along with the 2-3 quiz problems, totalling 5-6 problems graded. I will not share which homework problems will be graded ahead of time, so it is necessary to do all the homework. Grades will be according to the following scale:

Homework Assignments + Quizzes:	420 (14 assignments, 30 points each)
Group Project Assignments:	120 (3, 40 points each)
Final Project:	80 (2, 40 points each)
Final Exam:	80
<hr/> TOTAL:	<hr/> 700

We will use a scale no more strict than the following to guide assignment of final grades :

630 – 700 points (90% – 100%)	A- to A+
560 – 629 points (80% – 90%)	B- to B+
490 – 559 points (70% – 80%)	C- to C+
420 – 489 points (60% – 70%)	D- to D+

A grade of incomplete (I) will be considered only when circumstances beyond the student's control or that could not be anticipated prevented the student from completing the course requirements.

### **Policies on Late or Missed work:**

Homework sets are due each Monday in class. Late assignments handed in at the next class meeting earn half credit. Late assignments handed in after that earn no credit, but can get feedback. If you know you will be absent on a deadline, turn the assignment in early to earn full credit. Ideally give it to a classmate to hand in for you. Last resort, you can email a scan or legible photo of your work by 1:00 PM on Monday if you can't be there to hand it in in person.

If an in-class quiz is missed due to a University-sponsored activity, illness, or an emergency that could not have been planned for, that quiz can be made up (documentation for an emergency event will be requested). Please inform the instructor as soon as you know that you will miss a quiz to arrange an alternative time to take it. Quizzes missed without such a valid reason may not be made up, and will earn zero points.

### **Policies on Absence due to Illness:**

It is likely that someone will be ill for a period of time during the semester. These are considered excused absences, and in-class quizzes that fall within such a period can be made up.

### **Policies on "Regrades":**

Graded homework, quizzes, and group project assignments will be returned as quickly as grading can be completed. Grading errors occur from time to time, and will be corrected if found, and you are welcome to ask questions about why something was graded the way it was, and can appeal for a change to the earned points if you believe I misread or misunderstood something written. Please review your returned work promptly.

### **Accommodations:**

Students who have arrangements with the Student Disability Center for accommodations for exams or assignments should let the instructor know as soon as possible when the course begins so appropriate arrangements can be made.

**Collaboration, Cooperation, and Academic Integrity:**

A University education is a pursuit of knowledge, and must be based on truth and integrity. Academic dishonesty undermines this foundation and diminishes the value of a University education, and is not acceptable. You can expect your instructors to act with integrity and honesty and they will expect academic integrity and honesty from you as well.

Collaboration and group discussion are encouraged and a useful tool to help you learn the material in the course, and the group project assignments are designed to be completed collaboratively. By handing in homework, exams, and projects you certify that this is your own work or the work of the group. You are encouraged to discuss homework solution strategies with fellow students, but the final write-up must be your own. The homework assignment write ups and exams MUST represent your own work to provide an accurate assessment of your understanding of the course materials and your own ability to communicate this understanding in writing.

Exams are to be completed with only allowed notes, and no other references, and without collaboration, unless the exam instructions specifically permit or provide some additional material. Exams may include an honor pledge to affirm you have neither given nor received unauthorized assistance on the exam.

Concerns about the course or any of the instructor's decisions that affect your participation and/or performance in the course should be discussed first with the instructor. Concerns regarding the course may also be discussed with Prof. Clayton Shonkwiler, the Director of the Undergraduate Program. To see Dr. Shonkwiler, make an appointment with the Department of Mathematics main office (Weber 101).

If academic integrity is compromise, at a minimum, violations will result in a grading penalty in this course and a report to the Student Resolution Center. More information can be found at <http://tilt.colostate.edu/integrity>.

**CSU Resources:** The following link provides policies relevant to courses and resources to help with various challenges encountered - <https://col.st/2FA2g>.

**Addenda and Amendments:**

I reserve the right to amend (or clarify) this course description at any time. You will be notified in class of any changes. It is your responsibility to attend class or have someone in class notify you of any announcements.