

# Math 311 Spring 2020

## Ordinary Differential Equations

MWF 1:00-1:50PM (Keyes 102)

**Professor:** Evan Randles  
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**Office Hours:** Monday 2:00-3:30PM, Tuesday 5:30-7:00PM,  
Thursday 5:00-7:00PM, & by appointment

**Course Website:** <http://personal.colby.edu/~erandles/M311.html>  
**Personal Website:** <http://personal.colby.edu/~erandles/>

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(TA Office Hours: Wednesday 6:00-8:00PM and Thursday 6:00-8:00PM in Davis 209A)

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*Among all mathematical disciplines the theory of differential equations is the most important. It furnishes the explanation of all those elementary manifestations of nature which involve time. – Sophus Lie*

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**Course Description:** Welcome to the beautiful and fascinating world of ordinary differential equations! The main focus of this subject is to deduce long-term behavior of quantities from knowledge of their short-term rates of change. As mathematics is said to be the language of classical science, differential equations is a fundamental part of its grammar.

In this course, you will learn to analyze ordinary differential equations and a number of concrete situations modeled by them. To inform this study, we will develop a number of analytical and graphical techniques which will leverage on your knowledge of calculus and linear algebra. We will study general existence and uniqueness theory for ordinary differential equations and their corresponding initial value problems. Together, we will learn a host of solution techniques that will allow us to solve certain ordinary differential equations, including linear differential equations and linear systems. In this way, we will build a “solution toolbox” that you will take away from this course. These solution techniques are however limited, as we will learn, and there are many differential equations – those appearing in most real-world problems – which have no closed-form solutions. To make sense of these equations, we will study numerical methods (algorithms) for approximating solutions. Time permitting, we will also study the basics of dynamical systems theory, including nonlinear dynamics, chaos and bifurcation theory.

**Prerequisites:** Mathematics 122 or 162, and 253.

**Course notes and supplementary course material:** In lieu of an official textbook, our

main source of material for the course is the MA311 Course Notes, available on the course website. You are expected to read the notes carefully, thoroughly, and – ideally – before you come to class. Though the course notes are fairly extensive, they are still a work in progress. I therefore strongly encourage (not require) you to obtain a copy of *Elementary Differential Equations and Boundary Value Problems* by Boyce and DiPrima for additional reference; any edition  $\geq 2$  is acceptable. There are a number of other excellent textbooks on this subject and, should you plan to continue your studies of differential equations beyond this course, I also encourage you to take a look at *Ordinary differential Equations* by Paul Blanchard, Robert L. Devaney and Glen R. Hall; *Ordinary Differential Equations* by V. W. Noonburg; and *Nonlinear Dynamics* by Steven Strogatz.

**Grading:** Your grade will be calculated as follows:

Class participation:	5%
Weekly homework assignments:	15%
Project:	10%
Minimum of Midterms 1 & 2:	15%
Maximum of Midterms 1 & 2:	25%
Final Exam:	30%

**Exams:** This course will have two midterm exams and a final exam. The exams will be at the following dates and times:

<b>Midterm 1</b>	<b>Wednesday, March 11th from 7:00-9:00PM</b>
<b>Midterm 2</b>	<b>Monday, April 13th from 7:00-9:00PM</b>
<b>Final Exam</b>	<b>Friday, May 15th from 6:00-9:00PM</b>

The midterm exams will both be held in Lovejoy 100. It is crucial that you reserve these time slots for these exams. In the event that you are unable to attend a midterm exam, you must let me know at least **two weeks** prior to the exam date.

**Attendance and Class Participation:** As participation is a big part of this course, class attendance is required. Excuses may be granted for critical emergencies (normally verified by the Dean of Students) and illness (normally verified by the College Health Center). Absences for official Colby activities require prior approval and absences for religious reasons will be considered excused if the policy in the college catalogue is followed. To learn mathematics, it is essential to communicate it and to discuss it with others. I encourage you to ask questions! You will be required to participate in class discussion and you will frequently be called on during lecture. Failure to adhere to these policies, including missing too many classes ( $\geq 3$ ), will result in grade penalties, academic warnings, and eventually dismissal from the class.

**Homework:** Homework is the most important part of this course. It is where you will grapple with new ideas, come up with creative solutions and communicate your thoughts and understanding to others. Consequently, it is crucial that you take homework very seriously. You should start homework early and work diligently. If you are having substantial difficulty with a particular exercise, please come talk to me during office hours. I am here to help! You are permitted and encouraged to discuss homework with your classmates, however, when it comes time to write up your solutions, you are required to do so independently and away from your peers (in another room, preferably). You are also permitted to consult other textbooks and, in this case, please give full details (beyond what's in our textbook). If you work with peers or consult material outside the textbook,

you are required to cite your sources (including naming the peers with whom you worked); failure to do so is a matter of academic dishonesty and will result in grade penalties and/or reports of academic negligence/dishonesty. Your solutions should communicate your individual process and understanding of the material. What you turn in must be your own.

I expect homework solutions to be written out correctly and presented in good mathematical prose. Your grade will depend on the correctness of your solutions and the quality of your writing. This means that your writing should follow a coherent logical structure which makes use of complete sentences and follows standard rules of grammar. Please do not submit solutions containing incoherent and unstructured calculations. You should be proud of the material you turn in!

*Homework Structure and Schedule:* Assignments will be posted to the course website and are to be submitted in class on their due date (which usually falls on a Friday). It is crucial to keep up with the homework in this course. Therefore, short of the circumstances discussed in the attendance policy above, late homework will not be accepted. I will drop your lowest homework score on the condition that you attend one department colloquium and write a short (one paragraph) summary.

*Homework Policies:*

1. All write-ups are to be submitted in hard copy. They should be single-sided with no more than one problem per page, i.e., if a homework assignment has 5 problems, you should turn in at least 5 pieces of paper.
2. Each paper you turn in should have your name and the due date printed clearly at the top.
3. Your write-ups should be paper-clipped. You should staple all papers corresponding to a single exercise together, but please paper-clip (not staple) the group of exercises together. It is your responsibility to make sure that your homework is complete and all pages are accounted for.
4. If you used technology in the solution of the problem, please provide the complete printout showing all code, inputs and outputs in sequence, and annotate the printout with comments explaining what is being done in each step.

**Project:** In addition to homework, there will be a special project (assigned in around week 7). For this assignment, you will practice mathematical writing while attacking a longer and more challenging problem. As with the homework, I expect your project write-up to be correct, well-written, and presented in good mathematical prose. Your grade will depend on the correctness of your solutions and the quality of your writing. We will discuss this project in much more detail (including grading policies and a thorough descriptions of my expectations) soon.

**My Email Policy:** I love talking about mathematics and I always prefer to do it in person. For this reason, I like to, whenever possible, reserve email for logistical things. However, when you are stuck and cannot come see me in person, please feel free to email me. I am here to help!

As my life is busy and I have many responsibilities, I usually only check and respond to email once per day and sometimes not at all on weekends. For this reason, I try to uphold the following 24-48 hour rule: If you send an email Sunday through Thursday, I will do my best to respond

within 24 hours. If you send an email on Friday or Saturday, I will do my best to respond within 48 hours. If I do not respond within these windows, feel free to email me again as I may have missed it.

**Academic Integrity:** Honesty, integrity, and personal responsibility are cornerstones of a Colby education and provide the foundation for scholarly inquiry, intellectual discourse, and an open and welcoming campus community. These values are articulated in the Colby Affirmation and are central to this course. You are expected to demonstrate academic honesty in all aspects of this course. If you are clear about course expectations, give credit to those whose work you rely on, and submit your best work, you are highly unlikely to commit an act of academic dishonesty.

Academic dishonesty includes, but is not limited to: violating clearly stated rules for taking an exam or completing homework; plagiarism (including material from sources without a citation and quotation marks around any borrowed words); claiming another's work or a modification of another's work as one's own; buying or attempting to buy papers or projects for a course; fabricating information or citations; knowingly assisting others in acts of academic dishonesty; misrepresentations to faculty within the context of a course; and submitting the same work, including an essay that you wrote, in more than one course without the permission of the instructors.

Academic dishonesty is a serious offense against the college. Sanctions for academic dishonesty are assigned by an academic review board and may include failure on the assignment, failure in the course, or suspension or expulsion from the College.

For more on recognizing and avoiding plagiarism, see the library guide at the following website: [libguides.colby.edu/avoidingplagiarism](http://libguides.colby.edu/avoidingplagiarism)

### *The Colby Affirmation*

Colby College is a community dedicated to learning and committed to the growth and well-being of all its members.

As a community devoted to intellectual growth, we value academic integrity. We agree to take ownership of our academic work, to submit only work that is our own, to fully acknowledge the research and ideas of others in our work, and to abide by the instructions and regulations governing academic work established by the faculty.

As a community built on respect for ourselves, each other, and our physical environment, we recognize the diversity of people that have gathered here and that genuine inclusivity requires active, honest, and compassionate engagement with one another. We agree to respect each other, to honor community expectations, and to comply with college policies.

As a member of this community, I pledge to hold myself and others accountable to these values.