Math 311 Fall 2020
Ordinary Differential Equations

MWF 1:00-1:50PM (Mudd 405)

Professor:	Evan Randles
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Office:	Davis Science Center 209
Drop-in Office Hours:	Monday 3:00-4:00 PM, Tuesday 8:00-9:00PM
	(Zoom link on Moodle)
Individual Office Hours (All via Zoom):	Available at `https://calendly.com/erandles/ioh`.
Course Website:	`http:https://moodle.colby.edu/my/`
Personal Website:	`http://personal.colby.edu/~erandles/`

Teaching Assistants:	Sarah Pazik	sepazi21@colby.edu
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(TA Office Hours: Monday 8:00-9:00PM and Tuesday 7:00-8:00PM via Zoom. Zoom links available on Moodle.)

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 Moodle page. 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 ≥ 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:

Preview reading assignments:	10%
Weekly homework assignments:	30%
Minimum of Interviews 1 & 2:	15%
Maximum of Interviews 1 & 2:	25%
Final Project:	20%

Interviews: In lieu of midterm exams, we will have two interviews. In these interviews, we will meet one-on-one (in person or via Zoom) and I will ask you questions about the course material and you will have an opportunity to demonstrate your knowlege of ordinary differential equations and your analytical skills. Though we will discuss these interviews (in detail) in a couple of weeks after the course begins, you can expect to be given a list of "fair game" topics for the interview, from which I will randomly choose questions. We will schedule the interviews (roughly) 1/3 and 2/3 of the way through the semester – the dates for which are TBD.

Final Project: You will culminate your experience in this course by completing a final project. For this assignment, you will practice mathematical writing while attacking a substantial and 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.

Attendance and Class Participation: To learn mathematics, it is essential to communicate it and to discuss it with others. As much of your work this semester will take place outside of class (watching videos, reading, doing homework) it is vital that we use every bit of group work time to your advantage. Your attendance to the in-class (or remote group-work) portions of this course is therefore very important, and required when possible. I understand that this semester is highly unusual and you may at any point be required to quarantine; please keep me informed of your status in this regard. If you are quarantining, but in good health, you should still complete the activities; of course, excuses will 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.

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 participate in the many virtual office hours for this course ("drop-in" or individual meetings). 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 Moodle page and are to be submitted in Moodle as a PDF file (typed or handwritten and scanned); these will generally be due on Wednesdays. 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 not accepted. *Homework Policies:*

1. All write-ups are to be submitted in PDF and should be typed or very legibly handwritten and scanned. They will always be submitted via Moodle as a single PDF file. If you would like to learn how to typset mathematics in LaTeX, please email me and I'll help you get started.

2. 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.

Office Hours: This semester, to maintain best practices of social distancing, office hours will be held exclusively online. For my office hours, I have set aside two "drop-in" time slots, Mondays 3:00-4:00PM & Tuesday 8:00-9:00PM, where you will be able to join an active Zoom call and ask questions with your peers. These drop-in times are open to all and can be accessed directly from the course Moodle page. I have also set aside a large block of time for individual office hour appointments. These 15-minute individual appointments can be reserved at `https://calendly.com/erandles/ioh`. Note: These individual appointments must be reserved at least four hours in advanced and I ask that students (at least initially) reserve no more than two time slots per week. I strongly encourage all of you to regularly take advantage of both "drop-in" and "individual" office hours. The teaching assistants for the course will also hold weekly "drop-in" office hours. Information for these office hours can be found on the course Moodle page.

Contacting Me: I love to talk about mathematics and, while I usually prefer to do it in-person, meeting virtually is a good approximation and is beneficial to the safety of the Colby community. Consequently, I strongly encourage you to take good advantage of the many office hour times I have, both "drop-in" and individual. If you cannot attend (at least some of) these virtual office hours, please let me know immediately. Though I strongly prefer meeting over Zoom, you can also

start a Moodle discussion or email me directly about small logistical things and I will do my best to get back to you as soon as possible. At present, I am receiving around 50 emails per day and so I ask that you give me 24 hours to respond; if I do not respond in that window, it is likely that I have missed your email and you should feel free to send another one.

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 person's work or a modification of their 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.

Academic Accommodations: I am available to discuss academic accommodations that any student with a documented disability may require. Please note that you'll need to provide a letter from the Dean of Students Office documenting your approved accommodations. Please meet with me within two weeks of the start of the semester to make a request for accommodations so that we can work together with the College to make the appropriate arrangements for you. Kate McLaughlin, Associate Director of Access and Disability Services (kmclaugh@colby.edu) is the primary contact for accommodations and any questions related to educational testing and documentation.

Mental health: I care about my students' well-being and understand they may face mental health challenges. Students are encouraged to seek support from the College's available resources, including your advising dean and Counseling Services. (For immediate care, please call 207-859-4490 and press "0" to reach the on-call counselor.) I am willing to discuss reasonable accommodations during a crisis, but to fulfill our educational mission, students are expected to adhere to the attendance policy. Failure to do so because of mental health challenges may require consultation with the Dean of Studies Office.

Athletic Participation: While Colby College is supportive of athletic participation by its students, academics takes priority over athletics. Both NCAA and Colby rules prohibit missing class for competitions; the student must meet with the professor as soon as possible to discuss these overlaps. The student may request permission to miss class and make up the missed work, but the instructor has final authority either to grant or to withhold permission. If you are on an athletic team, you should speak with me in person about any potential absences as soon as possible.