

MATH 212 DIFFERENTIAL EQUATIONS

FALL 2018

Instructor: Dr. Jonathan Hulgan

Email: jonathan.hulgan@emory.edu

Office: Pierce 122

Phone: 4-4509

Office Hours: Tuesday and Thursday 2:00–5:00

Textbook: Dennis Zill, *A First Course in Differential Equations with Modeling Applications*, 10th Ed.

Course Content: Mathematics 212 is a first course on ordinary differential equations. The course includes appropriate topics involving first-order differential equations, linear differential equations, linear systems, and series solutions.

Course Goals: At the end of the course, the students should be able to solve various ordinary differential equations (o.d.e.) by various methods; be familiar with and be able to apply the main points in the general theory of o.d.e.s; and be able to investigate some qualitative aspects of a given o.d.e. even if it cannot be solved explicitly.

Prerequisites: The two introductory calculus courses (Math 111 and 112) are prerequisites for this course. Students are expected to be very familiar with concepts from calculus, including limits, differentiation rules, techniques of integration, and power series.

Honor Code: Oxford College is a community of scholars. As scholars, we are interested in pursuing truth and becoming more adept at our individual contribution to this pursuit. As a community, we have certain expectations of—and responsibilities to—each other in our scholarly endeavors. The Honor Code is the document detailing expected behaviors as members of this community, as well as the means by which these expectations are upheld; a copy of this document is available at <http://oxford.emory.edu/catalog/regulations/honor-code.html>.

Generally, if permission is not given in writing to use a certain resource—including collaboration with other people—then any use of that resource in the completion of an assignment constitutes a violation of the Honor Code. While completing in-class assignments, all personal papers and cell phones must be put away for the duration of the assessment. Students who have taken an exam, test, or quiz must not discuss the content or nature of the assessment until all students have completed the assignment. Any graded out-of-class assignments should be completed using only the resources explicitly permitted in that assignment's written instructions. The guidelines listed here are not intended to be exhaustive; if you are uncertain about any aspect of how an assignment is to be completed, ask first!

Class Attendance: The student is responsible for the course material discussed in class; therefore, the student is expected to attend all classes. Generally, students who attend class on a regular basis perform better on assessments than those who elect to be absent occasionally. Students accumulating four or more absences will be referred to the associate dean of academic affairs. In addition to the regular class meetings, tests and gateway exams are scheduled for certain Tuesday and Thursday mornings, as indicated on the calendar included with this syllabus.

Homework: Students who thoughtfully engage with course material on a regular basis are more likely to demonstrate a high level of performance on tests and quizzes. A collection of suggested problems will be provided at most class meetings; each assignment should be completed before the next class. A homework assignment is not considered “complete” until the student is able to produce a full solution for each problem without any sort of assistance. The amount of time required to complete a

homework assignment can vary from student to student, but mastering each assignment is the most important aspect of preparation for this course; it is worth investing the time necessary to do it! Any resource may be used in the completion of daily homework assignments.

Written Style: Thoughts are expressed through sentences, even in mathematics. Mathematical arguments will often use symbols to efficiently convey complex ideas, but these notions are still communicated through sentences. Note “ $1+1 = 2$ ” is a complete sentence: it has the subject “ $1+1$ ”, verb “ $=$ ”, and predicate “ 2 ”. It is important to clearly communicate solutions using appropriate mathematical symbols and complete sentences; pertinent work needs to be neat and orderly to be intelligible. Taking time to be neat while working problems often eliminates careless mistakes and allows the writer (and ultimately, the audience) to focus on the main concept at hand.

Absences: It is the student’s responsibility to notify the instructor as soon as possible in the event of an absence from an assessment. If an excused absence from a test is known in advance—such as those due to official school functions or religious holidays—arrangements can be made to take the test ahead of time. Missing a test due to an emergency will be handled on a case-by-case basis; such absences must be documented (e.g. a doctor’s note in case of illness) in order to be excused.

Grading: The student’s final course grade will be determined as follows:

Modeling Projects	100 points
Problem Sets	100 points
Tests	300 points
Final Exam	200 points
<hr/>	
TOTAL	700 points

In general, letter grades will be determined as follows, based on points each student earns: A: at least 630 points; B: 560-629 points; C: 490-559 points; D: 420-489 points; F: fewer than 420 points. Grades of A-, B+, B-, C+, C-, D+ may be assigned for sums of points near these cut-off totals.

Modeling Projects: The study of differential equations plays an important role in the development and application of mathematical models for phenomena across a variety of disciplines. There will be two projects where students develop and explain a model for some measurable phenomenon.

Problem Sets: Most weeks, a small collection of problems will be assigned for a grade. These will generally be completed outside of class, but occasionally students will be asked to complete them in class (much like a quiz). These assignments serve as an incentive for students to keep current with the course material, as well as a means to provide formative feedback on solution technique and style in preparation for each test. At least two of the lowest problem sets will be dropped for each student; the average of the remaining scores will be used to determine each student’s overall problem set grade.

Tests: Three tests will be given throughout the semester on the Tuesday and Thursday mornings indicated on the course calendar at the end of this syllabus. Students are expected to take tests at the scheduled times. Conflicts, problems and emergencies will be handled on an individual basis; arrangements for legitimate conflicts must be made far in advance to take a test prior to the scheduled testing time.

Final Exam: The final exam is comprehensive and will be given on **December 18 at 2:00 p.m.** according to the exam schedule. Students must obtain permission from the Associate Dean of Academic Affairs to take an exam earlier or later than scheduled. Permission may be granted for medical reasons or for participation in educational programs. Any Student who has three exams on the same calendar day (not within a general twenty-four hour period) must document their situation with the Associate Dean for Academic Affairs no later than 5:00 p.m. on Reading Day. Students in this

situation will be granted permission to work with one of their instructors to arrange to take one exam at an alternate date (within exam week). You may NOT receive permission to alter your exam schedule for the following reasons: Taking an earlier flight/ride, vacation schedule, weddings (other than your own), graduation or job schedule.

Religious Holidays: Instructors are encouraged, not required, to accommodate students' academic needs related to religious holidays. Please make every effort to negotiate your religious holiday needs within the first two weeks of the semester; waiting longer may compromise your instructor's ability to extend satisfactory arrangements. If you need guidance negotiating your needs related to a religious holiday, the College Chaplain, Rev. Lyn Pace, ppace@emory.edu, Candler Hall 202, is willing and available to help. *Please be aware that Rev. Pace is not tasked with excusing students from classes or writing excuses for students to take to their professors.* Emory's official list of religious holidays may be found at http://www.religiouslife.emory.edu/faith_traditions/holidays.html.

Accessibility: If you have a documented disability and have anticipated barriers related to the format or requirements of this course, or presume having a disability (e.g. mental health, attention, learning, vision, hearing, physical or systemic), and are in need of accommodations for this semester, we encourage you to contact the Office of Accessibility Services (OAS) to learn more about the registration process and steps for requesting accommodations at oas_oxford@emory.edu. If you are a student that is currently registered with OAS and have not requested or received a copy of your accommodation notification letter, please notify OAS immediately. Students who have accommodations in place are encouraged to coordinate sometime with your professor, during the first week of the semester, to communicate your specific needs for the course as it relates to your approved accommodations. Accommodations are not implemented until the instructor is provided an accommodation letter and discusses the accommodation plan for this course face to face with the OAS student. All discussions with OAS and faculty concerning the nature of your disability remain confidential. For additional information regarding OAS, please visit the website: <http://accessibility.emory.edu>.

Inclusivity: Oxford College of Emory University's ideals of inclusivity compel us to foster an environment where people of diverse backgrounds, identities, abilities, and ideologies are affirmed, respected, and seen as a source of strength—where we strive to learn together, and ultimately thrive communally. When these ideals are not upheld, we encourage discussion to better understand and spur action towards improvement. In my teaching, I always aim to challenge your thinking, but never to challenge your identity. If there is anything I can do to help you feel more comfortable and engaged (pronoun usage, calling on you more often, calling on you less frequently, etc.), please let me know.

Support Services: Students should utilize the following resources:

- **Office Hours:** Changes to office hours will be posted on Canvas. These times vary due to meetings and other obligations, but most afternoons should have some availability.
- **Canvas:** Announcements and important documents will be posted on the course's Canvas site. The student is responsible for regularly checking the site for new announcements and resources, including homework assignments and handouts.
- **Math Center:** Student tutors are generally available in the Math Center in Pierce Hall Monday through Thursday afternoons. Additional online resources from the Math Center are available at <http://www.oxfordmathcenter.com>.
- **Study Groups:** When used appropriately, study groups can be a useful tool in learning mathematics. Study groups should complement and enrich individual study of course material; with particular regard to homework assignments, it is suggested that study groups discuss completed

(or attempted) assignments rather than work through homework problems for the first time.

THE HONOR CODE OF OXFORD COLLEGE APPLIES TO ALL WORK SUBMITTED FOR CREDIT IN THIS COURSE. BY SUBMITTING SUCH WORK, YOU PLEDGE THAT WORK WAS DONE IN ACCORDANCE WITH THE RULES STIPULATED ON THE ASSIGNMENT AND IN THIS SYLLABUS.

TOPICS BY DAY
Math 212, Fall 2018

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Aug 27th	Aug 28th	Aug 29th 1 Introduction to differential equations	Aug 30th	Aug 31st 2 Direction fields and autonomous differential equations
Sep 3rd No CLASS (Labor Day Holiday)	Sep 4th	Sep 5th 3 Separable differential equations	Sep 6th	Sep 7th 4 Linear differential equations
Sep 10th 5 Exact differential equations	Sep 11th	Sep 12th 6 Solving by substitution	Sep 13th	Sep 14th 7 Euler's Method
Sep 17th 8 Linear first-order models	Sep 18th	Sep 19th 9 Non-linear first-order models	Sep 20th	Sep 21st 10 Modeling with systems of equations
Sep 24th 11 Test 1 wrap-up	Sep 25th Test 1 (7:45AM)	Sep 26th 12 Intro to higher-order linear differential equations	Sep 27th	Sep 28th 13 Reduction of Order
Oct 1st 14 Homogeneous linear equations with constant coefficients	Oct 2nd	Oct 3rd 15 Undetermined coefficients	Oct 4th	Oct 5th 16 Variation of parameters
Oct 8th No CLASS (Fall Break)	Oct 9th	Oct 10th 17 Cauchy-Euler equations	Oct 11th	Oct 12th 18 Systems of linear equations

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Oct 15th 19 Nonlinear equations	Oct 16th	Oct 17th 20 Linear models: initial value problems	Oct 18th	Oct 19th 21 Linear models: boundary value problems
Oct 22nd 22 Introduction to series solutions	Oct 23rd	Oct 24th 23 Test 2 wrap-up	Oct 25th Test 2 (7:45AM)	Oct 26th 24 Series solutions: ordinary points I
Oct 29th 25 Series solutions: ordinary points II	Oct 30th	Oct 31st 26 Series solutions: singular points	Nov 1st	Nov 2nd 27 Matrices and matrix operations
Nov 5th 28 Eigenvalues and eigenvectors	Nov 6th	Nov 7th 29 Introduction to linear systems	Nov 8th	Nov 9th 30 Homogeneous linear systems I
Nov 12th 31 Homogeneous linear systems II	Nov 13th	Nov 14th 32 Nonhomogeneous linear systems I	Nov 15th	Nov 16th 33 Nonhomogeneous linear systems II
Nov 19th 34 Test 3 wrap-up	Nov 20th Test 3* (7:45AM)	Nov 21st NO CLASS (Thanksgiving Recess)	Nov 22nd	Nov 23rd NO CLASS (Thanksgiving Recess)
Nov 26th 35 Numerical solutions I	Nov 27th	Nov 28th 36 Numerical solutions II	Nov 29th	Nov 30th 37 Numerical solutions III
Dec 3rd 38 Integral transforms I	Dec 4th	Dec 5th 39 Integral transforms II	Dec 6th	Dec 7th 40 Integral transforms III
Dec 10th 41 Final review	Dec 11th	Dec 12th	Dec 13th	Dec 14th Final Exam: 12/18 at 2PM