# Math 212 - INQ Differential Equations
# Oxford College of Emory University
# Fall 2014


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| **Instructor:** | Dr. Ricardo Conceição |
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| **Phone:** | 4-4657 |
| **Office Hours:** | To be announced on Blackboard. |


**Course Content:** First and second-order ordinary differential equations, systems of ordinary differential equations, power series solutions, applications.

**Course Objectives:** At the end of the course the student should:

- Be familiar with the general ideas of ordinary differential equations;
- Be able to apply the following methods to the solution of differential equations:
  - separation of variables, integrating factor, reduction of order, undetermined coefficients, variation of parameters and power series;
- Be able to solve:
  - homogeneous linear equations with constant coefficients, system of linear first-order equations, first-order exact equations;
- Be able to apply the theory to model some real-life system and/or phenomenon.
- Be able to use technology (Eg. Sage/Wolfram Alpha) to analyze solutions to differential equations and their applications.

**Reference:**

- Main Text: *Elementary Differential Equations and Boundary Value Problems* by William E. Boyce & Richard C. DiPrima.
- The secondary source is a free online textbook: *Differential equations and Sage*, by Marshall Hampton.
- Writing in Math: *Clean Writing in Mathematics*, pp. 413 – 420 in Calculus: An Historical Approach, by William Priestley.

Any additional material needed for this class will be provided in class or via Blackboard at

`https://classes.emory.edu/`

**Writing intensive:** This course satisfies the Continuing Writing Requirement. The bases for this are the weekly review essays, problem sets, and research project (see below). Thoughts are expressed by sentences: just so in mathematics. All work must be in complete sentences. Good mathematical style is expected. Further the student's writing must be clear, concise and logically correct. There are other references listed on Blackboard to aid the student.

**Ways of Inquiry:** "Ways of Inquiry"(INQ) courses are designed to introduce students to the specific ways knowledge is pursued in each discipline through active engagement in the discipline's method of analysis. INQ courses start with questions, are student-centered and often collaborative, and they place increasing responsibility on students for their own learning. Students not only experience each discipline's distinctiveness but also move beyond its boundaries to understand connections with other disciplines and fields.

**Grading Policy:** Students' grades are determined by performance on weekly review essays, problems/quizzes, Sage projects, tests, a research project and a comprehensive final exam. All tests will be administered during class time, unless special circumstances require otherwise.

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| Sage Projects | 100 |
| Problems/Quizzes | 100 |
| Weekly review essays | 200 |
| 2 Tests @ 100 ea. | 200 |
| Research Project | 200 |
| Final Exam | 200 |
| Total | 100% |

Maximum grade cuts are as follows:

| A | B | C | D | F |
|---|---|---|---|---|
| 90-100% | 80-89.99% | 70-79.99% | 60-69.99% | 0-59% |

Plus/minus grades may be assigned for percentages near the maximum grade cuts. Also, I reserve the right to amend, append, or otherwise make changes to the plan for the course.

**Sage projects:** We will use *Sage*[1], a free computer algebra system, to explore certain computational aspects of differential equations. The first project and an introduction on how to use Sage is posted at the Blackboard website.

**Problem sets/Quizzes**: Problem sets are due at the BEGINNING of class on the date indicated on the assignments. **Points will be deducted for a lack of organization, illegible or sloppy work, and the inappropriate use of mathematical symbols, even if answers found are correct**.

Also, an undetermined number of quizzes will be given throughout the semester. Quizzes need not be announced ahead of time. **There is no provision for making up a quiz. You will receive a zero on any missed quiz.** Grades on problem sets are treated identically to those on quizzes.

**Weekly review essays:** These are due **each week on Friday**, excepting weeks in which there is a test and the first week. Each is to review, with comments and examples, the subject covered in the previous week or so. Each may provide alternate explanations of things, amplify or clarify the successes or failures of the text, and should show some serious thought about some part of the course. Interdisciplinary connections are particularly appreciated. Outside sources are permissible; keep in mind that each review will be evaluated on the quality of the student's own reflections. If outside sources are used, be sure to cite them appropriately and to avoid plagiarism as defined in

[1]Found at `http://www.sagemath.org/` and `http://prep.sagenb.org/`.

the Honor Code. Unsatisfactory reviews must be rewritten to receive credit. References, samples and detailed directions about the weekly review will be provided later.

**Tests:** There will be two tests. The Oxford Honor Code applies to both tests and is **individual effort** on all portions. The tests will be on Monday, October 6, and Friday, November 14.

**Research project:** A research project investigating one of several special topics will be due at the end of the term. The project will consist of both a written and (possibly) an oral component. A rough draft is due in class on November 19. The final draft is due in my office by noon, Tuesday, December 9. Further details of the project will be given at the appropriate time in the semester.

**Final Exam:** Comprehensive with no exemptions. *Please make sure to check your final exam schedule before making any trip arrangements.*

**Class Attendance:** Students are responsible for all material covered in class and any changes to the syllabus that may be announced. Any conflicts between the course schedule and religious holidays are to be negotiated in advance with one's instructor. Please be on time, do NOT use your cell-phone and participate.

**Calculators:** We may use a simple scientific calculator. Calculators that compute derivatives and integrals are not allowed.

**Expectations:** They're high! I expect that you will read the text (several times) and attempt all the assigned homework (and more). Written responses to questions should be **grammatically correct!** I welcome your comments, criticisms, and suggestions. Please feel free to stop by my office or e-mail me with any concerns or questions that you may have.

Good luck and I hope this will be an enjoyable experience for all of you!

**The Honor Code of Oxford College applies to all work submitted for credit in this course. To receive credit for work submitted you must place your name on it. By placing your name on such work, you pledge that the work has been done in accordance with the given instructions and that you have witnessed no Honor Code violations in the conduct of the assignment.**

*Student work submitted as part of this course may be reviewed by Oxford College and Emory College faculty and staff for the purposes of improving instruction and enhancing Emory education.*

**List of Topics**
**Math 212**
**Fall 2014**

1. Sage Notes: Introduction - Motivation
2. Section 1.3: Classification and Solutions of a DE
3. Section 2.2: IVP & Separation of Variables
4. Section 2.8: Existence and Uniqueness of solutions
5. Section 2.1: Integrating Factors
6. Section 2.6: Exact Equations
7. Sage Notes: Solutions by substitutions
8. Section 3.1: 2nd Order ODEs - Linear Homogeneous Equations
9. INQ Project: Slope Fields
10. Section 3.2: The Wronskian and independence of solutions
11. Section 3.1, 3.3: Homogeneous Equations with Constant coefficients - Complex Roots
12. Section 3.4: Reduction of Order
13. Section 3.6: Variation of Parameters
14. TEST 1
15. Section 3.5: Undetermined coefficients
16. Section 4.1: Higher order linear ODE
17. Section 4.2: Homogeneous with constant coefficients
18. Section 4.3: Undetermined Coefficients
19. Section 5.1: Power Series - Review
20. Section 5.2, 5.3: Power series solution: Ordinary points
21. Section 5.4, 5.5, 5.6: Euler Equations and Regular singular points
22. Section 7.1, 7.2 , 7.3: Algebra of Matrices
23. Section 7.4, 7.5, 7.6, 7.8: Systems of first order linear DEs
24. TEST 2
25. INQ Project: Euler's Method
26. Miscellaneous of topics