Ordinary Differential Equations

MATH 304, TR 11:00am - 12:15pm, Swords 359, Fall 2018

Professor Reginald McGee

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Office Hours: Monday 1:30-3:00pm, Tuesday 1:30-3:00pm, Wednesday 2:00-3:00pm, or by appointment.

Required Text: *Differential Equations*, Fourth ed., Paul Blanchard, Robert Devaney and Glen Hall

Course Prerequisites: MATH 244 (Linear Algebra)

Course Content: This is an applied mathematics course focusing on ordinary differential equations, that is, equations relating the derivatives of unknown functions to themselves. There are literally thousands of differential equations used to model phenomena in all kinds of fields including physics (mechanics), chemistry (reactions), biology (population models), neuroscience (brain functioning), economics (the Black-Scholes equation), astronomy (space craft trajectories), and fluid dynamics (turbulence). Any natural process that involves a change over time can be modeled with a differential equation.

We will utilize three different approaches to studying ordinary differential equations (ODEs): analytic, numerical and qualitative techniques. Since most differential equations are too large in dimension or too difficult to solve explicitly, qualitative methods play an important role in modern research. With the rapid growth in technology, using computers to approximate and visualize solutions has also become increasingly common. In order for you to obtain an appreciation for this aspect of the field, several computer projects using the software package DE Tools (included with the course text) will be assigned.

We will cover most of the material from Chapters 1 through 5, and possibly a brief visit to chapter 6, if time permits. A rough outline of the semester follows:

- Introduction to ODEs and overview of the course (1 class)
- First-Order Equations: population models, separation of variables, slope fields, Euler's method, existence and uniqueness theorems, phase lines, bifurcations, solving linear equations (11 classes)
- Exam I
- Systems: physical examples, vector fields, Euler's method, the Lorenz equations (5 classes)
- Planar Linear Systems: eigenvalues and eigenvectors, analytic solutions, sketching phase planes, the trace-determinant plane (8 classes)
- The Harmonic Oscillator: 2nd-order equations, forced oscillators, resonance (3 classes)
- Exam II
- Nonlinear Systems: equilibria, stability, nullclines, Hamiltonian systems (4 classes)
- Laplace transforms and linear operators (3 classes)
- Final Exam

Homework: There will be homework due nearly every Thursday at the START of class, except for weeks when a midterm exam takes place. Assignments will be posted on the course web page. There will be a list of problems assigned, a nonempty subset of which will be graded. Solutions to all problems will be posted immediately after the assignment is due.

While you are allowed and encouraged to work on homework problems with your classmates, the solutions you turn in to be graded should be your own. Take care to write up solutions **in your own words**. Plagiarism will not be tolerated and will be treated as a violation of both the departmental policy on academic integrity and the college's policy on academic honesty.

NOTE: LATE homework will NOT be accepted. I will drop your lowest homework grade at the end of the semester.

Computer Projects: There will be several computer projects assigned over the course of the semester using the software package DE Tools included with the course text or dfield/pplane available online. Each project will explore some real world application of differential equations and may require some supplementary reading. Projects will be completed in groups of 2 to 3 people with one report to be turned in for the entire group.

Exams: There will be two midterms and a comprehensive final at the end of the semester. Please make a note of these dates and plan accordingly. Any conflicts must be legitimate and brought to my attention well before the scheduled exam date. If you have any specific learning disabilities or special needs and require accommodations, please let me know early in the semester so that your learning needs may be appropriately met. You will need to contact the director of Disability Services in Hogan 209 (x 3693) to obtain documentation of your disability. We will review for the midterms during the Monday class on the week of the exam.

	Exam 1	**Tues. October 2nd**	**in class**
Tentative Exam Schedule:	**Exam 2**	**Thurs. November 1st**	**in class**
	Final	**TBA**	

Any end of semester travel arrangements must be made for after the final exam period

Grade: Your course grade will be based on the following breakdown:

- classroom participation/interest 5%
- homework and computer projects 35%
- midterm exams 35%
- final exam 25%

E-mail Policy: I will only respond to class-related emails from your **"g.holycross.edu"** address. In the subject line of your email, you must include the name or number of the course so that I know to respond in an appropriate timeframe. Please identify yourself in your email, and do not send attachments without first discussing it with me. It is sufficient to send the attachment in a separate email after describing it in a prior email.

Academic Integrity: The Department of Mathematics and Computer Science has drafted a policy on academic integrity to precisely state our expectations of both students and faculty with regards to cheating, plagiarism, academic honesty, etc. You are required to read this policy and sign a pledge agreeing to uphold it. A violation of the Departmental Policy on Academic Integrity will result in a 0 for that assignment (or exam) and a letter describing the occurrence of academic dishonesty will be sent to your Class Dean.

The College's Academic Integrity Policy can be found: `https://catalog.holycross.edu/node/1381#AHP`

Disability Statement: Any student who feels the need for accommodation based on the impact of a disability should contact the Office of Disability Services to discuss support services available. Once the office receives documentation supporting the request for accommodation, the student would meet privately with Disability Services to discuss reasonable and appropriate accommodations. The office can be reached by calling 508-793-3693 or by visiting Hogan Campus Center, room 215A.

If you are already registered with Disability Services, please be sure to get your accommodation letters and deliver them to your instructors in a timely fashion. Instructors need 4-5 days advance notice to be able to facilitate the process of receiving testing accommodations.

How to do well in this course:

- Attend class, participate, and ask questions.
- Work with your classmates. Organize study groups.
- Be an active, engaged learner.
- Do your homework regularly.
- Read the text. (It even has a few jokes!)
- Start working on homework as soon as it is assigned.
- Do a little work each day.
- Good time management skills are essential in a college math course.
- Spend as much time as is necessary to complete each assignment.
- Read and work through the book and go over your lecture notes.
- The best way to learn math is by doing it.
- If necessary, do more problems than are assigned, especially if you feel uncomfortable about how you understand the material.
- Find out how to do every homework problem.
- Never leave work undone or not understood.
- Material which is studied today will be used tomorrow.
- Seek help when you do not understand something!