# Department of Mathematics, UAB
# Introduction to Differential Equations
# MA252-OQ Summer 2020 Remote

**Instructor:** Professor Ian Knowles, Room 4024, University Hall.
**Email:** iknowles@uab.edu
**Class Meeting Times:** MWF: 11:20am – 12:40pm.
**Office Hours.** After class; you may also email for a private Zoom appointment.
**Textbook.** None: we use my lecture notes; download these from the class website.
**Grading.** There will be approximately one written modeling project per week; these collectively will constitute 50% of the course grade. There will be two Zoom tests, around the end of June and July; each counts 25% of the course grade. There is no final examination in this course
**Maple Software.** Access to Maple software is required for this course. Maple student edition may be purchased at a 25% discount directly from Maplesoft
**Homework and Test File Submission.** For each homework assignment and test you are required to submit a **single pdf file** on or before the due time to my email address above. For assignments that use Maple you can use the "save as pdf" printing option inside Maple. If you prefer to use paper, homework sheets and printed test files can be scanned to a single pdf file using a mobile scanning app such as Adobe Scan, for example.
**Prerequisite Course.** Calculus II (MA126), or permission of instructor.
**Term Dates.** First day of classes: Monday June 08, 2020. Independence Day (UAB Holiday): Friday July 03, 2020. Last day of classes: Friday August 07, 2020.
**Archiving of Class Lectures.** It is my intention to record each of our Zoom meetings and make them available on Canvas as mp4 files.

**Syllabus.** This is a first course in ordinary differential equations from a modern perspective. A hundred years ago it was important for engineers and scientists to be familiar with a myriad of clever mathematical tricks aimed at producing closed-form solutions for differential equations (DEs) of interest. In the last thirty years or so, this process has been both extended and simplified by the ready availability of powerful software, such as Maple, for numerical computations and computer algebra applications. It is the aim of this course to provide both the theoretical background needed to understand how DEs work, and familiarity with the various software tools needed to facilitate their use in modeling.

We cover first order differential equations (separable, linear, exact, and additional non-linear examples using Maple), modeling with first order DEs, examples of systems of first order DEs, theory of higher order linear DEs (homogeneous and non-homogeneous, superposition of solutions, linear independence (via Wronskians) and general solutions, initial and boundary value problems), solution of constant coefficient homogeneous linear equations, non-homogeneous linear equations by variation of parameters and Green's functions, with complicated cases done using Maple, and the theory and application of Laplace transforms. Modeling projects in the course will emphasize the use of Maple to do the heavy lifting.

**Assignment Rules.** All assignments must be your own work; do not copy the work of others or allow your work to be copied. Each assignment must be written as a report in your own words, adhering to the guidelines listed below. Points may be deducted for transgressions of these rules. You can add commentary to a Maple worksheet using the Maple "text" facility, or leave space for the later insertion of hand-written material; see the sample assignment:

1. Your **name**, **class** (MA252-OQ), **semester** (Summer 2020), and **assignment number** appears at the beginning of your report.
2. **Each question and part of question must be clearly numbered; the questions (and parts thereof) must appear in INCREASING order in your report.**
3. Add text commentary explaining each Maple step (or group of steps).
4. Use the Maple text editor to interleave text and Maple material. You can mix Maple and hand-written text by leaving a space in your Maple file for later insertion of your hand-written material. **No "Maple appendices"**[1] **permitted.** Your report should be a logical and continuous blend of explanatory text and Maple output.
5. Clearly label your answers and/or conclusions.

**Reference Books.** As mentioned above, there is no prescribed textbook for this course. Many books, such as *A First Course in Differential Equations with Modeling Applications*, Dennis G Zill, Brooks/Cole, any edition, or *Elementary Differ-*

[1] i.e. all of the Maple output glomped together at the end of the report

*ential Equations and Boundary Value Problems*, William E. Boyce and Richard C. DiPrima, Wiley, any edition, cover well the theoretical material in the course.

Likewise, there is no text for the modeling component of the course, which we will do as an in-class/homework activity. Regular class attendance is highly recommended for this reason. I will provide files for the assignments and Maple work, and review problem files for the tests.

**Aims of the Course.** Upon successful completion of the course a student should

- be familiar with the standard types of ordinary differential equation and their methods of solution;
- understand that differential equations provide a precise quantitative connection between the laws of Physics and modeling applications in Science and Engineering;
- be able to use computer algebra software (such as Maple) to facilitate the computations that arise in the context of practical modeling projects.