

Course Outline: Math 3860-003, Spring 03

Introduction

Welcome to Differential Equations! A differential equation is an equation relating a variable quantity to its derivatives. The “unknown” in a differential equation represents a function, not a number. The most basic differential equations are the integration problems you studied in Calc II: for example, integrating $\sin^2(t)$ is the same as solving the equation $y' = \sin^2(t)$ for the unknown y . For this reason the solution of a differential equations is called the integral, and its graph is called an integral curve.

The study of differential equations is not so much the study of a general theory, as was much of calculus, but of special examples. There are two reasons for this. First of all, differential equations are interesting mainly because they ideally express real-world relationships between dynamic quantities. Almost any analysis of forces or energy leads to a differential equation, for example.

Second, expressing the integral of a differential equation in a formula is usually impossible. If you look back at integral calculus then you will see that, despite the fact that the Fundamental Theorem guarantees an antiderivative for every continuous function, there are very few techniques for finding formulas for these antiderivatives. Even relatively innocent looking functions such as $f(t) = \sin(t^2)$ do not have antiderivatives which can be written out in explicit formulas.

However, we often need to answer qualitative questions in real-world applications, and often these can be answered without knowing explicit formulas for the solutions. In fact, it is often the case that the formula for the solution of a differential equation is so complicated it doesn't help us answer our qualitative, real-world questions. Thus much of this semester will focus on methods for analyzing the solutions of a differential equation using only qualitative techniques, especially graphical techniques.

Moreover, when quantitative results are needed there are very good methods for quickly approximating the solutions of differential equations. So, we will also spend a fair amount of time looking at some of these approximation schemes.

Keep this in mind. The point of studying differential equations is to gain insight into some dynamic processes. Hence you should expect some of the exam questions to come directly from applications, and to require answers at least partly in complete sentences, not simply mathematical formulas.

Office hours

My office is UH 4080e. The phone number is 419 530 2975. My email address is paul@livetoad.com. The web page for this course can be found at <http://livetoad.com/>. My official office hours: Monday, Wednesday, and Friday, 10:00 to 10:50 pm, in UH 4080e. This means that you can call or stop at these times without an appointment and I am sure to be there. I am also available at other times, but for these you must make an appointment. Feel free to ask for office hour appointments at other times if you cannot make it to my official office hours. If you call me when I am not in my office then you can leave a voice mail message and I will get back to you as soon as I can. I tend to list to my voice mail messages only on Monday, Wednesday, or Friday mornings before class, so often email is a faster way to get in touch with me.

Text and syllabus

The material in this course is covered in chapters 1–3 and 5–9 of *Elementary Differential Equations*, 7th edition, by W Boyce and R DiPrima. A detailed calendar appears below.

	ML King Day	Mon	20 Jan
Exam 1:	Calc review	Wed	22 Jan
Exam 2:	1.1–1.3, 2.1–2.5	Mon	10 Feb
Exam 3:	2.7–2.8, 8.1–8.3	Wed	26 Feb
	Last Day to Withdraw	Fri	7 Mar
_____ Spring Break: 8 Mar thru 16 Mar _____			
Exam 4:	7.1, 7.3–7.6, 9.1–9.5	Mon	24 Mar
Exam 5:	3.1–3.8	Mon	14 Apr
Exam 6:	5.1–5.3, 6.1–6.4, 3.8-3.9	Fri	9 May, 10:15am

Prerequisites

This course is not very difficult. In fact I believe you will enjoy it, provided you are comfortable with the prerequisite calculus. I have found that if students have any difficulty in this course it is with derivatives and integrals. This is material you are supposed to have learned in Calc I and Calc II. (Almost nothing from Calc III is necessary for this course.) However, perhaps because of co-op or because you are coming back to school after a break you might be out of practice with derivatives, integrals, power series, graphing, or other skills or concepts from basic calculus. Thus we will spend the first week reviewing techniques and concepts from basic calc. The first exam, on Wednesday, 22 January, will cover this prerequisite material. The problems for this exam will be chosen from a list of review problems that I have posted on the web. Your score on this first exam should give you a clear picture of how well you can expect to do in this class.

Assignments

I will post homework assignments every Monday (except the first). The assignment will be due at the beginning of class on the following Monday. The grader will grade 3 problems, chosen at random. Thus each homework assignment is worth 3 points. Your solutions must be neat and show all work. If you do not show your work then you will not receive credit for your solution. When you turn in your assignment fold your papers lengthwise, and write your name, the course number, and due date on the outside.

Exams

We will have 5 short exams, each with 5 10-point questions. You may not use a calculator of any kind on any of the exams. The exam questions will be taken directly from the homework assignments, except for exam 1, whose questions will be taken from the calc review problems posted on the web. For the exams I may change the numbers, functions, and parameters in the questions but I will not change the form of the questions.

Attendance

I will not accept late assignments under any circumstances. It will not affect your final grade if you miss an assignment or two, since each assignment is only worth 3 points. However, if you are in the habit of missing classes and assignments regularly then probably you will fail. Making up missed assignments will not help. There will be no exceptions to this rule. Don't ask.

I will give make-up exams only in case of a documented emergency, such as illness or a funeral. If you are sick the day of the exam then you must call or email that same day if you expect to be able to make up the exam. Otherwise you must arrange for a make-up exam ahead of time. If I am not in my office then you can leave a voice mail message. If you fail to show up for an exam and do not contact me about it until afterwards then you will not be able to make up that exam — you will get a 0 for that exam.

Grades

I will determine final grades based on the class-wide distribution of points earned. I want to emphasize that you are not in direct competition with each other. I do not feel obligated to give any grades of F, or any grades of A for that matter. I will not split hairs. I do not have a set grade scale. You will find that the grade distribution breaks into obvious groups. Historically in my classes it takes 85–90% of the points to earn an A; around 70–75% for a B; and around 60% for a C. However, these are not rigid targets, just historical observations. After the first exam I will post a histogram of total points earned, and this should give you a clearer idea of where you stand.

If you want me to post your grades under a nickname then bring me a 3×5 card with your name, an email address, and the nickname you want to use — preferably something not obvious!