MA 341-001: Applied Differential Equations I

Summer I 2020

Instructor:	Hassan Hatam
Time and Place:	Self-Paced with Remote Instruction TBD
Office:	Zoom Meetings
Email:	hhatam@ncsu.edu
Office Hours:	TBD

Course Description: This three credit hour course initiates the study of differential equations and systems of differential equations with some applications. We introduce methods for solving differential equations, including the Laplace transform, phase plane analysis, and also some numerical methods. We introduce matrix techniques for systems of ordinary differential equations. Credit is not allowed for both MA 341 and MA 301. Upon completing this course, you (the student) should be able to

- Determine if a given function is a solution to a particular differential equation and apply the theorems for existence and uniqueness of solutions to differential equations appropriately;
- Distinguish between
  - **(i)** linear and non-linear differential equations;
  - **(ii)** ordinary and partial differential equations;
  - **(iii)** homogeneous and non-homogeneous differential equations;
- Solve ordinary differential equations and systems of differential equations using direct integration, separation of variables, methods of undetermined coefficients and variation of parameters, and Laplace transform methods.

Course Format: The course in its entirety will be delivered and administered remotely. You will view pre-recorded videos according to a weekly viewing schedule. There will also be live weekly problem sessions held via Zoom. Homework will be assigned regularly, and will be completed online via WeBWorK. We will have three in-term tests and one final exam, all administered remotely. Office hours will be held weekly via Zoom as well.

Textbook: We will use the text *Fundamentals of Differential Equations and Boundary Value Problems* by Nagle, Saff, and Snider, 7^{th} edition, Addison Wesley. Lectures will roughly—but not precisely—follow the presentation in the text.

Course Materials: Each student is expected to obtain the course textbook, be able to access homework assignments on WeBWorK, and have access to the course Moodle page. The Moodle page—which is accessible through Wolfware—will serve as the central hub for

the course. This is where announcements are made, course documents (such as this syllabus) are kept, notes from problem sessions are posted, and all links to Zoom sessions, office hours, the WeBWorK page, as well as tests and the final exam can be found.

Course Videos: The primary instructional component of the course consists of pre-recorded videos from a previous iteration of the course delivered by Leslie Kurtz of our Department of Mathematics at NCSU. A suggested weekly viewing schedule can be found at the end of this syllabus as well as separately on the Moodle course page. The precise days and times for viewing the videos is up to you, but make sure that you have viewed the videos corresponding to homework assignments and tests before these assessments are due/take place.

Problem Sessions: Problem sessions will be held live via Zoom (a remote conferencing app available for free to NCSU students logging in with their Unity IDs, see https://ncsu.zoom.us/ if you haven't already used Zoom) on Tuesdays and Thursdays at times agreed upon by the class. The sessions will last an hour (or an hour and half occasionally as needed), during which time I will work out problems, provide examples, and answer questions related to homework or the material. The problem sessions will be recorded and made available on the Moodle page.

Homework: Homework will be assigned regularly and is an important component of the course. Homework assignments will be announced each week and are linked through the course Moodle page to the course WeBWorK page. When accessing the homework, please do so through the Moodle page, at least the first time you do so (and preferably always), since Moodle will automatically generate a WeBWorK account for you. Many of the techniques and methods we will learn require a fair bit of practice to master, and the homework sets are intended to provide such practice, as well as to elucidate the concepts contained in the current section. I strongly urge that you keep up with homework by working some amount of problems every day. If you feel like the assigned homework is not giving you enough practice, there are many problems in the course text that you can work for extra practice.

Tests and Final Exam: We will have three in-term tests and a final exam. No cooperation or outside help is allowed on tests or the final exam, but the exams will all be open book, open notes, and open to the resources available on the course webpages. All tests and the final exam can be found on the Moodle page on the appropriate date and will be timed. Your lowest in-term test grade will be dropped. The dates for the tests and final exam are as follows.

Test 1:	Friday, May 22
Test 2:	Wednesday, June 3
Test 3:	Friday, June 12
Final Exam:	Wednesday, June 17
	OR Thursday, June 18

The final exam will be cumulative, and will be available on two days in case you might have other exams to take, and you will be able to decide the setting for it yourself.

If an in-term test is missed with an excused absence (that is, university-approved reason, with supporting documentation), then a make-up test may be scheduled individually. If the reason for such an absence is known before the test date, then the make-up test be requested **before the normal test date**. The setting for the make-up will be determined by me with input from the student(s) who missed the test, and the topics covered may not be exactly identical to the ones on the missed test. If an in-class test is missed due to an unexcused absence, then no make-up will be given, and the test will be marked with a score of zero. All absences that require a make-up test or other special accommodations must go through the NCSU absence verification process, which can be found at https://dasa.ncsu.edu/students/absence-verification-process/. Note that you will have some flexibility regarding the time you take a test on test days.

Grading Policy: The final grade for the course will be based on a ten point scale as follows:

A :	90	-	100
B :	80	-	89
C :	70	-	79
D :	60	-	69
F :	0	-	59

The cutoffs for ± grades will be determined at the end of the course. Your final grade will be determined as follows:

Homework	15%
In-term Tests	50%
Final Exam	35%

Attendance and Class Participation: Attendance will not be taken at our Zoom live problem sessions, however, it is expected that you either attend these sessions, or view the recordings between sessions. Reference might be made in problem sessions to material explained in past sessions. Participation during the Zoom live sessions—by asking or answering questions, for instance—is encouraged, particularly if there is any trouble understanding the material.

Office Hours: I will hold office hours weekly at times to be announced once class has formally begun. If you are unable to visit during the given office hours but wish to see me, you may email us to schedule an appointment, and I will do my best to accommodate you. Office hours may be subject to change, and such changes will generally be announced via the Moodle page. Please come visit during office hours if you feel like you are falling behind, or if you have questions about the material or homework.

Course Policies: It is your responsibility to keep up with announcements, to obtain notes from Moodle or classmates for missed problem sessions, and to be aware of test dates and homework due dates. You may work on homework assignments in groups—in fact, this a good way to learn—but make sure you understand the material yourself.

Disability Resources: Reasonable accommodations will be made for students with verifiable disabilities. To receive accommodations, students must register with Disability Services for Students, which can be found at https://dro.dasa.ncsu.edu/. Please consult the Academic Accommodations for Students with Disabilities Regulations (REG02.20.1) for more information on NC State's policy on working with students with disabilities. You must discuss accommodations with me **prior** to an exam date.

Additional Resources: Tutoring is available at no cost through the University Tutorial Center. Visit https://tutorial.dasa.ncsu.edu/ for more information.

General Expectations/Keys to Success:

- Take good notes while viewing the course videos or problem sessions. Ask questions when you are confused.
- Keep up with homework and work extra problems if you feel you aren't getting enough practice. It is important not to fall behind early. A good strategy is to work on the assignments early and often, a bit at a time, rather than trying to finish an entire assignment the day it is due. It is also a very good idea to work homework problems on paper and to keep these pages in one place, so that you can review more easily for exams, detect errors, or be able to refer to your work when consulting with me or others.
- Importantly, check the Moodle site and your email regularly. It is your responsibility to be aware of announcements, especially regarding exam dates and homework deadlines.
- If you find yourself falling behind, please contact me by email, visit me during my office hours, or by appointment. It is also a good idea to get to know a few of your classmates so that you can support each other.
- **It is understood that your name or signature on any assignment or exam or online submission indicates your adherence to the NC State Honor Pledge: "I have neither given nor received unauthorized aid on this test or assignment."**

I hope you will find the course enjoyable, and I look forward to teaching and getting to know all of you this summer!

Suggested Video Viewing Schedule:

Week	**Sections**	**Topics**	**Video**
May 13–15	1.1–1.2	Solutions & Initial Value Problems	1
	1.3	Direction Fields	2
	1.3	Phase Line Supplement	2
	2.2	Separable Equations	3
	2.3	Linear First Order Equations	3
May 18-22	3.2	Applications	4
	3.3	Newton's Law of Cooling	5
	2.4	Exact Equations	5
	4.1–4.2	Introduction, Second Order Linear Equations	5
	4.2–4.3	Homogeneous Linear Eqs. Constant Coefficients: Real and Complex Roots	6
	4.4	Undetermined Coefficients	7
	4.5	Superposition Principle	8
		Test 1: May 22	
May 25-29	4.6	Variation of Parameters	9
	4.9–4.10	Free and Forced Mechanical Vibrations	10
	7.2	Definition of the Laplace transform	10
	7.2-7.3	Laplace transform: definition and properties	11
	7.4	Inverse Laplace Transform	12
	7.5	Solving IVPs with Laplace transforms	13
June 1-5	7.6	Transforms of Discontinuous Functions	14
	9.1-9.3	Systems of DEs and Linear Algebra	15
	9.4	Linear Systems in Normal Form	16
		Test 2: June 3	
June 8-12	9.5	Linear Systems of DEs with Constant Coefficients: Real Eigenvalues	17
	9.6	Linear Systems of DEs with Constant Coefficients: Complex Eigenvalues	18
	9.7	Nonhomogeneous Linear Systems	19
	9.7	Applications: Interconnected Tanks	19
	5.6	Coupled Mass-Spring Systems	20
		Test 3: June 12	
June 15-16	5.4	Phase Plane	21
	12.2	Linear Systems in the plane	21
	12.3	Almost Linear Systems	22
		Additional Review Video	23
July 17 & 18	All	**Final Exam**	