MATH 3323 SPRING 2020

INSTRUCTOR: NESTOR GUILLEN

Course overview

From the course catalog: "A course covering solutions to the more common types of ordinary differential equations, especially those of first and second order, with emphasis on geometrical and physical interpretations".

The objective of this course is for the student to gain practice in the craft and science of differential equations, which are used to describe, understand, and predict the behavior things in all kinds of fields of knowledge. We will emphasize the study of methods that produce explicit formulas for solutions, such as separation of variables, integrating factor, and variation of parameters. We will also discuss what it means for there to be a solution, whether that solution exists, or is even unique. The type of equations we will be able to solve to our complete satisfaction will be those with adjectives like separable, one dimensional, and linear. Other, far more complicated equations will be discussed briefly, and the methods to analyze and solve them will be left for more advanced courses.

The course will also cover some advanced method of solution, such as power series representation and Laplace's transform. By the end of the course the student will be able to recognize which of the known methods applies to a given problem, write formulas for solutions of various types of equations, and to infer qualitative properties of solutions to more complicated equations when explicit formulas are not available.

Prerequisites: Differential and integral calculus (limits, differentiation and integration techniques, series, basic Cartesian geometry). Familiarity with linear algebra is very helpful but not required – we will spend several lectures covering any linear algebra we need.

Textbook: Elementary Differential Equations and Boundary Value Problems. Boyce, DiPrima, Meade. 11th Edition.

The class will consist mostly from book chapters 1, 2, 3, 5, 6, and 7 (see course Schedule).

Lecture Times: Tuesday and Thursday 3:30 pm - 4:50 pm
Location: Derrick Hall 00117.

Office: MCS 468.
Office Hours: Tuesday and Thursday 2 pm -3:30 pm.
Virtual Office Hours: Fridays 9 am - 11 am.

My email: nestor@txstate.edu
Course website: `https://ndguillen.github.io/math3323Sp2020.html`

Course evaluation policies

Overview: There will be problem sets essentially every week (11 total), three exams (in class), and one final exam. The various evaluations have the following weights:

Problem sets: 30%
3 Exams: 30%, 15%, 0%
Final Exam: 25%
Bonus points: 1% extra point per bonus problem solved

Attendance requirement: Attendance will be taken during the first four weeks of the semester, missing 3 or more classes in that period will result in your being automatically dropped out of the class. Likewise, failure to submit two or more of the first 4 problem sets will also result in an automatic drop. If you believe you will not be able to meet this requirement you must let me know **in writing** before the end of the second week of classes – this however does not guarantee you will be exempted from the attendance requirement.

Problem sets: These amount to 30% of the final numerical grade and will be due on an almost weekly basis. Your lowest **FOUR** problem set grades are dropped when computing your problem sets average. Late problem sets will not be accepted: if you don't submit a problem set on time and in the required format you will be given a zero on that problem set. As your lowest 4 problem set grades are dropped, you could miss up to 4 problem sets and still be able to get a perfect final grade. Problem sets must be submitted on blank letter size paper and stapled –otherwise you will be given a zero on that problem set. Problem sets submitted via email, even if submitted on time, might not be given full consideration, you must submit the problem sets in person –exceptions might be granted under appropriate circumstances. If you have read this far into the first day handout, please write to my email right now indicating your preferred Hogwarts House (all Hogwarts Houses are respected in this class and your preference will have no impact on your final grade). If you don't have a preferred Hogwarts House simply say so in the email.

Exams: Exams corresponds to 0%, 15 %, 30 % of the final numerical grade, according to this rule: the best exam grade will be assigned 30%, the second best exam grade 15%, and the third best exam 0% (so your worst exam grade is dropped and you will be given more points for the exam you performed best in, regardless of whether it was the first, second, or third exam).

The final exam corresponds to 25% of the final numerical grade.

There will be no make up exams except for extraordinary circumstances causing your missing an exam, in such a case contact me as soon as possible. You are not allowed to use calculators or similar computing devices during the exam. You are allowed to bring one cheat sheet. The cheat sheet must be on a letter size page, and must be done by each student separately – it is meant in part, as a device to review the material before an exam by having you place in a single sheet of paper the information/tricks/formula you believe are important.

Grading of Problem Sets/Exams: You will receive graded problem sets/exams a week after they were submitted/taken. Solutions to the problem sets or exams will not be posted, but you are encouraged to stop by office hours to discuss the solution of any given problem. The book contains a list of answers to the problems at the end of each section, so you may consult those if you wish to practice on further problems.

Bonus points: Each problem set will have one or two Bonus Problems, providing a solution for such a problem (due when the respective problem is due and no later than that) will earn you one point (1%) for your final numerical grade. To illustrate this, if you your final numerical grade (before bonus points) is 83% and you earned credit for 7 bonus problems throughout the semester, your final grade will be 90% (corresponding to A). Bonus problems will be more challenging and you will only earn points if the solution is entirely correct (that is, you cannot earn partial bonus credits). However if you were to do say, half of all the bonus problems in the course (about 12) that would be worth in the same order as the 15% from the second best exam.

Exam Practice: A week before every exam I will post a list of practice problems meant to study for the exam, these are meant to help you get an idea of the type of questions in the exam and guide your studying. Solutions will not be posted for these sets either.

Important dates: Problem sets will always be mostly on Thursdays –see the class website for specific due dates for each problem set.

First problem set due January 23rd (**second day** of classes)
Roster certification February 12th
First Exam: February 27th
Second Exam: March 26th
Third Exam April 23rd
Final Exam Date TBA.

Final Course Grade: Your final numerical grade is placed on a scale of 100 (see below to see how this is calculated). Your final letter grade will be computed from

your final numerical grade according to the following table:

A 90-100

B 80-89.9

C 70-79.9

D 60-69.9

F 0-59.9

Accommodations and Accessibility

Student Accommodations: It is the University's goal that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on disability or pregnancy, contact the Office of Disability Services as soon as possible at 512-245-3451 to establish reasonable accommodations. Please be aware that the accessible table and chairs in this room should remain available for students who find that standard classroom seating is not usable. For further information, go to https://www.ods.txstate.edu/.

Supplemental Instruction (SI) Sessions:

Supplemental Instruction (SI) is a nontraditional form of tutoring provided by SLAC and Ingram School of Engineering that focuses on collaboration, group study, and interaction for assisting students in difficult courses. This program provides a trained peer who has already successfully completed the course to assist you. This peer, called the SI Leader, will attend this class each day, participate as any normal student (takes notes, exams, etc.), and then facilitate several one-hour study sessions per week for group study.

Please note that SI Leaders do not have administrative authority in this class and that attending session is not in any way a substitute for attending lecture!

If you have concerns regarding the SI program or wish to verify your number of sessions attended, please contact the Program Coordinators, Lindley Alyea (lindley@txstate.edu 512-245-2515) or Victor Capellan (victor@txstate.edu 512-245-2515)..

Class Schedule

Here is an approximate schedule for the class (it might be amended later, depending on the pace of class). Each lecture notes the relevant book sections.

(01/21) The exponential function and the simplest differential equation. (2.1)

(01/23) First order equations. Integrating factor. (2.1, 2.2).

(01/28) Differential equations, what they are and how to solve them. (1.1, 1.2)

(01/30) Separation of variables, and integrating factor revisited (continued). (2.1, 2.2)

(02/04) First order linear equations. Linear superposition (2.1, 2.2)

(02/06) Linear systems of differential equations (7.1, 7.2, 7.3)

(02/11) Vector spaces: basic notions and examples. (7.2, 7.3)

(02/13) Vector spaces: independence and bases. (7.2, 7.3)

(02/18) Vector spaces: matrices and matrix operations. (7.2, 7.4)

(02/20) Vector spaces: eigenvectors and determinants. (7.2, 7.3)

(02/25) Systems. Second order equations as first order systems. (7.4)

(02/27) **FIRST EXAM.**

(03/03) Picard's iterative approximations and Picard Theorem. (7.4, 2.8)

(03/05) Fundamental systems of solutions. Solutions via eigenvectors. (7.4, 7.5)

(03/10) Complex solutions. The complex exponential. (7.5, 7.6)

(03/12) More on second order systems. (7.5, 3.2)

(03/24) The exponential and non-homogeneous systems. (7.9)

(03/26) **SECOND EXAM.**

(03/31) Oscillations (mechanical and electrical), damped oscillators. (3.7, 3.8)

(04/02) Non-linear systems (autonomous equations). (2.5)

(04/07) More on Non-linear systems. (2.5, 2.7)

(04/09) Power series representation of solutions (part I). (5.1, 5.2)

(04/14) Power series representation of solutions (part II). (5.2, 5.3)

(04/16) Euler's and Bessel's equations (5.4, 5.7).

(04/21) Laplace's transform and its properties (6.1).

(04/23) **THIRD EXAM.**

(04/28) Solving linear equations via Laplace's transform (6.2).

(04/30) Differential equations with discontinuous ingredients (6.3, 6.4, 6.5).

(04/05) Convolutions and their uses (6.6).