Math 3410.003 and 3410.500: Spring 2017

Meets: TR 3:30-4:50 in Chilton Hall, Room 245.

Instructor: Professor John Quintanilla

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Office Hours: M 8:30-9:30 and 11-1, W 8:30-9:30 and 11-1, or by appointment. I'm fairly easy to find, and you're welcome to drop by outside of office hours without an appointment. However, there will be occasions when I'll be busy, and I may ask you to wait or come back later.

Required Text: *Elementary Differential Equations and Boundary Value Problems*, 10th edition, by W. E. Boyce and R. C. DiPrima.

Strongly Recommended: Lecture notes for the semester are available at the UNT Copy Center for approximately $18.

Course Description: First-order equations, existence-uniqueness theorem, linear equations, separation of variables, higher-order linear equations, systems of linear equations, series solutions and numerical solutions.

Prerequisite: Math 1720 (Math 2700 recommended). The prerequisite for this class is serious. The following is a partial list of topics that we will use as we progress through the semester. It's OK if, at the start of the semester, you're a little rusty on a handful of these topics. However, if you're not comfortable with a substantial fraction of these topics, then you should strongly consider dropping this class.

- Factoring polynomials: synthetic division, the Rational Root Test, and complex roots
- Solving systems of linear equations
- Trigonometry
  - Using trigonometric identities
  - Identifying properties of sinusoidal functions, including amplitude and period.
  - Using Euler's formula: $e^{ix} = \cos x + i \sin x$
- Techniques of differentiation
- Techniques of integration
  - u-substitution
  - Integration by Parts
  - Integration by Partial Fractions
  - Integration by Trigonometric Substitution
- Power series
  - Using the Ratio Test and/or Root Test to determine the radius of convergence
  - Finding the Taylor series (Maclaurin series) expansion of a given function
  - Knowing the Taylor series expansions of common functions

Course Topics

The following chapters and sections of the textbook will be covered according to the projected schedule below. Dates may change as events warrant.

Chapter 1 Introduction

- 1.1 Some Basic Mathematical Models; Direction Fields
- 1.2 Solutions of Some Differential Equations
- 1.3 Classification of Differential Equations
- 1.4 Historical Remarks

Chapter 2 First Order Differential Equations

- 2.1 Linear Equations; Method of Integrating Factors
- 2.2 Separable Equations
- 2.3 Modeling with First Order Equations
- 2.4 Differences Between Linear and Nonlinear Equations
- 2.5 Autonomous Equations and Population Dynamics

Chapter 3 Second Order Linear Equations

- 3.1 Homogeneous Equations with Constant Coefficients
- 3.2 Fundamental Solutions of Linear Homogeneous Equations; The Wronskian
- 3.3 Complex Roots of the Characteristic Equation
- 3.4 Repeated Roots; Reduction of Order
- 3.5 Nonhomogeneous Equations; Method of Undetermined Coefficients
- 3.6 Variation of Parameters
- 3.7 Mechanical and Electrical Vibrations
- 3.8 Forced Vibrations

Chapter 4 Higher Order Linear Equations

- 4.1 General Theory of *n*th Order Linear Equations
- 4.2 Homogeneous Equations with Constant Coefficients
- 4.3 The Method of Undetermined Coefficients

Chapter 5 Series Solutions of Second Order Linear Equations

- 5.1 Review of Power Series
- 5.2 Series Solutions Near an Ordinary Point, Part I
- 5.3 Series Solutions Near an Ordinary Point, Part II
- 5.4 Euler Equations; Regular Singular Points
- 5.5 Series Solutions Near a Regular Singular Point, Part I
- 5.6 Series Solutions Near a Regular Singular Point, Part II

Chapter 6 The Laplace Transform

- 6.1 Definition of the Laplace Transform
- 6.2 Solution of Initial Value Problems
- 6.3 Step Functions
- 6.4 Differential Equations with Discontinuous Forcing Functions
- 6.5 Impulse Functions
- 6.6 The Convolution Integral

Chapter 8 Numerical Methods

- 8.1 The Euler or Tangent Line Method
- 8.2 Improvements on the Euler Method
- 8.3 The Runge-Kutta Method

January 17	Lecture #1	1.1, 1.2	Introduction to ODEs
January 19	Lecture #2	2.1	First-order ODEs
January 24	Lecture #3	2.3	Applications of first-order ODEs
January 26	Lecture #4	2.2	Separable ODEs
January 31	Lecture #4	2.2	Separable ODEs
February 2	Lecture #5, 6	2.2, 2.4	Linear vs. nonlinear ODEs
February 7	Lecture #7	2.5	Autonomous ODEs; classification of stability
February 9	Lecture #8	3.1, 3.2	Real, distinct roots of the characteristic equation
February 14	Lecture #9, 10	3.3	Complex and repeated roots
February 16	Lecture #10, 11	3.5	Method of undetermined coefficients
February 21	Lecture #12	3.6	Variation of parameters
February 23	**Exam #1**	**Lectures 1-7**	**Review #1**
February 28	Lecture #13	3.7	Mechanical vibrations
March 2	Lecture #13	3.8	Mechanical vibrations
March 7	Lecture #14	4.1, 4.2	Higher-order ODEs
March 9	Lecture #15	4.3	Method of undetermined coefficients
SPRING BREAK			
March 21	Lecture #16	5.1	Review of power series
March 23	**Exam #2**	**Lectures 8-15**	**Review #2**
March 28	Lecture #17	5.2	Series solutions of ODEs, ordinary point
March 30	Lecture #18	5.3	Series solutions of ODEs, ordinary point
April 4	Lecture #19	5.4	Series solutions of ODEs, regular singular point
April 6	Lecture #20	5.5, 6.1	Introduction to Laplace transforms
April 11	Lecture #21	6.2	Properties of Laplace transforms
April 13	Lecture #22	6.3	Step functions
April 18	Lecture #23	6.4	ODEs and discontinuous forcing functions
April 20	Lecture #24	6.5	Impulse functions
April 25	Lecture #25	6.6	Convolution integrals
April 27	**Exam #3**	**Lectures 16-23**	**Review #3**
May 2	Lecture #26	8.1	Numerical methods of solving ODEs
May 4	Lecture #27	8.2, 8.3	Numerical methods of solving ODEs
May 9, 1:30-3:30	**FINAL EXAM**		**Review #4**

Student Responsibilities

- Student behavior that interferes with an instructor's ability to conduct a class or other students' opportunity to learn is unacceptable and disruptive and will not be tolerated in any instructional forum at UNT. Students engaging in unacceptable behavior will be directed to leave the classroom and the instructor may refer the student to the Center for Student Rights and Responsibilities to consider whether the student's conduct violated the Code of Student Conduct. The university's expectations for student conduct apply to all instructional forums, including university and electronic classroom, labs, discussion groups, field trips, etc.

- You should read over this syllabus carefully, as I will hold you responsible for the information herein.
- Students will be expected to read the chapters carefully, including the examples in the book.
- Students will be responsible for obtaining any and all handouts. If you are not in class when handouts are given, it is **your** responsibility to obtain copies.
- **You should begin working now.** Frequent practice is crucial to the successful completion of a mathematics course. Cramming at the last minute will certainly lead to failure.
- **WARNING:** If you are in academic trouble, or are in danger of losing your financial support, or if your parent or guardian is expecting a certain grade at the end of the semester... start working today. I will refuse to listen to any pleas at the end of the semester. You will receive precisely the grade that you *earn*.

Grading Policies

The following schedule is tentative and is subject to capricious changes in case of extracurricular events deemed sufficiently important to the upper administration.

Final Exam	Tuesday, May 9 1:30 – 3:30pm	23%
Exam 1	c. Week 5	19%
Exam 2	c. Week 9	19%
Exam 3	c. Week 13	19%
Class Project		8%
Homework		12%

A	90% and above
B	80% and below 90%
C	70% and below 80%
D	60% and below 70%
F	below 60%

Cooperation is encouraged in doing the homework assignments. However, **cheating will not be tolerated on the exams**. If you are caught cheating, you will be subject to any penalty the instructor deems appropriate, **up to and including an automatic F for the course**.

Attendance is not required for this class. However, you will be responsible for everything that I cover in class, even if you are absent. It is my experience that students who skip class frequently make poorer grades than students who attend class regularly. You should consider this if you don't think you'll be able to wake up in time for class consistently.

The grade of "I" is designed for students who are unable to complete work in a course but who are currently passing the course. The guidelines are clearly spelled out in the *Student Handbook*. Before you ask, you should read these requirements.

Exam Policies

- Unless announced otherwise, calculators will **not** be permitted for use on exams.
- I expect to give exams during the weeks above. However, these are tentative dates. I will announce the exact date of each exam in class.
- After exams are returned in class, you have 48 hours to appeal your grade. I will not listen to any appeals after this 48-hour period.
- I will not drop the lowest exam score; all will count toward the final grade.
- No make up exams will be given. For those students who miss an exam due to an **Authorized Absence** (see the *Student Handbook*), the final grade will be computed based only on those exams taken, together with homework/quiz scores and the final exam. Such students will be required to provide *official written* verification of such an absence.
- Students missing an exam for unauthorized reasons will receive 0 (zero) points on the exam.
- The Final Examination will be comprehensive in the sense that problems may come from any of the sections that will be covered during the semester.
- The grade of A signifies *consistent* excellence over the course of the semester. In particular, an A on the final is not equivalent to an A for the course.
- I reserve the right to test and quiz you on problems which are generalizations of material covered in the class and/or in the text. In short, the problems may not look exactly like the ones in the book.
- Everything that I say in class is fair game for exam material. You will be responsible for everything unless I advise you to the contrary.

Homework Policies

- Homework will be assigned every Tuesday and will be due the following Tuesday.
- I expect the assignments that you turn in to be written up carefully and neatly, with the answers clearly marked. You must show all of your work. **Messy homework will not be accepted.**
- Entire homework assignments will **not** be graded. Instead, only two or three representative problems will be graded per assignment. As a consequence, it will be possible to not do the entire assignment and still receive a perfect score on that particular assignment. **Deliberately leaving homework uncompleted is highly unrecommended**, however, as the law of averages will surely catch up with you as the semester progresses.
- When computing grades, I will drop the **two** lowest homework grades before computing the homework average. Therefore, in principle, you could get a 100% homework score and also not turn in two assignments during the semester. I have this policy in case you get sick, a family emergency arises, etc., during the semester. You will still be responsible for the material in such assignments during the examinations.
- Because of this policy, I will **not** give extensions on homework assignments, nor will I accept late assignments.

Note to TNT Students

- If you're pursuing secondary teacher certification through Teach North Texas, then you may be aware that you will be required to construct a preliminary teaching portfolio in EDSE 4500 (Project-Based Instruction) and a final portfolio during your final semester of student teaching. Section 2 of this portfolio will ask you to demonstrate your knowledge of your content field. You may find that some of the assignments may naturally become artifacts toward part of this task, and so I encourage you to keep your work after the semester is over to make the eventual construction of your portfolio easier. You may even want to write (and save for later) a brief reflection on the artifact you select, rather than try to remember why the artifact you chose was important once you reach EDSE 4500.
- The specific indicators in the portfolio related to knowledge of mathematical content are as follows:
    - Reflect on one or more artifacts in which you state a mathematical theorem or conjecture and apply both formal and informal mathematical reasoning to the same conjecture.
    - Reflect on one or more artifacts that show your ability to describe a mathematical concept that can be represented in multiple ways and articulate the connections between its representations in clear, expository prose. Where relevant, identify appropriate technology for exploring the concept and explain limits the technology may place on the knowledge acquired.
    - Reflect on one or more artifacts that show your ability to generate a model of a natural phenomenon or describe an already existing model and evaluate how well the model represents the situation, including consideration of the risks, costs, and benefits of the alternatives.
    - Reflect on one or more artifacts that show your ability to identify a topic in your subject area and describe its connection with prerequisite topics, future topics, and other subjects.
    - Reflect on one of more artifacts that show how you bring out the historical and cultural importance of your subject material, its contribution to large ideas, and its significance in today's society. Include a specific lesson plan that incorporates the general history and cultural context of modern science or of mathematics as these fields have evolved.
- Just to be clear: the above is a suggestion for TNT students. This is NOT a course requirement for Math 3410.

Final Note

In compliance with the Americans with Disabilities Act, I mention the following: It is the responsibility of students with certified disabilities to provide the instructor with appropriate documentation from the Dean of Students Office.