**Honors Differential Equations II**

**MAP 4303**



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**Time:**

**Office hours:**

# Course Description: This course provides further techniques to solving ordinary differential equations, as well as applying techniques from linear algebra to solve systems of first-order linear differential equations. This course also introduces partial differential equations and their solutions, focusing on their applications to physics and engineering. Topics include eigenvalues and eigenvectors, autonomous systems and stability, Liapunov’s Method, Fourier series, and Laplace’s Equation.

### Prerequisite: MAP 2302 – 3 Credit Hours

## Course Goals/Objectives: The main goal of this course is to provide students with an understanding of techniques in differential equations and linear algebra as well their applications in analyzing and solving complex problems in engineering, the natural sciences, and economics.

Upon successful completion of Differential Equations II, the student will be able to:

* Utilize tools from linear algebra to solve systems of first-order linear differential equations.
* Solve physical problems involving a number of separate elements linked together in some relation, such as electrical networks and problems in mechanics.
* Use a geometric approach to solve nonlinear differential equations.
* Understand the qualitative behavior of solutions, rather than focusing on the detailed quantitative information.
* Solve partial differential equations using the method of separation of variables.
* Use Fourier series to solve differential equations containing a series of trigonometric functions.
* Apply partial differential equations to solve problems arising from heat conduction, wave propagation, and potential theory.
* Solve Sturm-Liouville boundary value problems, and generalize the method of solution for partial differential equations.
* Apply Liapunov’s Method and the Laplace equation to solve real-world problems.

**Textbooks:**

* Elementary Differential Equations and Boundary Value Problems, 9th Ed. (2010) by Boyce & DiPrima
* Solution Techniques for Elementary Partial Differential Equations, 2nd Ed. (2010) by Constanda
* Schaum’s Outline for Differential Equations, 3rd Ed. (2009) by Bronson & Costa (recommended)

## Student Evaluation:

Tests (60%): There will be four in-class exams, each one covering a chapter in the textbook. Each exam will count for 15% of the final average for a total of 60% of the final grade.

Quizzes (10%): There will be frequent in-class quizzes throughout the semester in order to closely monitor student progress and adjust instruction accordingly.

Homework (5%): There will be assigned homework problems for each section in the textbook that is covered in this course. As quizzes and tests are based on these problems, students are required to complete these problems on their own. Class time will be devoted to discussion of these problems daily or on an as needed basis.

Final Exam (25%): The final exam is comprehensive, and will count for 25% of the final grade.

Grading Scale: The student’s grade will be calculated as a percentage and reported to Florida Atlantic University as a letter grade using the following scale.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 93.50 – 100.0 | A |  | 72.50 – 76.49 | C |
| 89.50 – 93.49 | A– |  | 69.50 – 72.49 | C– |
| 86.50 – 89.49 | B+ |  | 66.50 – 69.49 | D+ |
| 82.50 – 86.49 | B |  | 62.50 – 66.49 | D |
| 79.50 – 82.49 | B– |  | 59.50 – 62.49 | D– |
| 76.50 – 79.49 | C+ |  | ≤ 59.49 | F |

## Make Up Policy: It is the student’s responsibility to ask for all work missed following an excused absence. The student will be given one day for each day of excused absence with which to complete and submit missed homework assignments (not including the day they return to campus). In the event that a quiz or test is missed due to a excused absence, the student needs to contact the instructor immediately to schedule their make-up assessment; as with homework assignments, a student will be given one day for each day of excused absence with which to complete an alternate version of the missed assessment.

**Workload and Assistance**: You should expect to spend **6 to 9 hours each week**, outside of class, on the course material. This includes reading, completing homework assignments and projects, and studying for quizzes and exams. If at any time during the semester you find yourself having difficulty with the material, please come see me as soon as possible. You will find it much easier to learn new topics if you consistently keep up with the course material and homework problems.

**Classroom Etiquette Policy:** In order to enhance and maintain a productive atmosphere for education, personal communication devices, such as cellular telephones and pagers, are to be disabled in class sessions.

**Policy on Accommodations:** In compliance with the Americans with Disabilities Act (ADA), students who require reasonable accommodations due to a disability to properly execute coursework must register with the Office for Students with Disabilities (OSD) -- in Boca Raton, SU 133 (561-297-3880); in Davie, LA 240 (954-236-1222); in Jupiter, SR 110 (561-799-8010); or at the Treasure Coast, CO 117 (772-873-3441) – and follow all OSD procedures.

**Academic Integrity Policy:** Students at Florida Atlantic University are expected to maintain the highest ethical standards. Academic dishonesty is considered a serious breach of these ethical standards, because it interferes with the university mission to provide a high quality education in which no student enjoys an unfair advantage over any other. Academic dishonesty is also destructive of the university community, which is grounded in a system of mutual trust and places high value on personal integrity and individual responsibility. Harsh penalties are associated with academic dishonesty. For more information, see University Regulation 4.001.

The FAU policy is found here: <http://www.fau.edu/regulations/chapter4/4.001_Code_of_Academic_Integrity.pdf>

**Note of Honors Distinction:**This course differs substantially from the non-Honors version.   First, the writing component of the course will be much more demanding, and will prepare students for upper-division college writing and for work on the **Honors Thesis**.  Students will be exposed to vocabulary of a specifically theoretical nature, and will be expected to comprehend these new mathematical concepts and to deploy these new terms in their own critical thinking and writing. Students will be expected to familiarize themselves with the history and the ongoing critical and scholarly conversation about the course topics.  Most importantly, this course will reflect the interdisciplinary nature of Honors education and will inculcate critical attitudes and skills that will teach you how to learn for yourself.

## Course Outline

The following material will be covered during the semester:

* Chapter 7 – Systems of First-Order Linear Equations
  + Review of Linear Algebra and Matrices
  + Eigenvectors and Eigenvalues
  + Basic Theory of Systems of First Order Differential Equations
  + Homogeneous Linear Systems with Constant Coefficients
  + Complex Eigenvalues
  + Fundamental Matrices
  + Repeated Eigenvalues
* TEST 1
* Chapter 9 – Nonlinear Differential Equations and Stability
  + Phase Space: Linear Systems
  + Autonomous Systems and Stability
  + Almost Linear Systems
  + Competing Species
  + Predator-Prey Equations
  + Liapunov's Second Method
  + Periodic Solutions and Limit Cycles
  + Chaos and Strange Attactors
* TEST 2
* Chapter 10 – Partial Differential Equations and Stability
  + Two-Point Boundary Value Problems
  + Fourier Series
  + Convergence of Fourier Series
  + Even and Odd Functions
  + Separation of Variables
  + The Heat Equation
  + The Wave Equation
  + Laplace's Equation
* TEST 3
* Chapter 11 – Boundary Value Problems and Sturm-Liouville Theory
  + Sturm-Liouville Boundary Value Problems
  + Nonhomogeneous Boundary Value Problems
  + Singular Sturm-Liouville Problems
  + Bessel Functions
  + Series of Orthogonal Functions
* TEST 4

**Additional literature:**

“Partial Differential Equations for Scientists & Engineers” (1993) by Farlow

“Partial Differential Equations with Fourier Series and Boundary Value Problems”, 2nd Ed. (2004) by Asmar

“Applied Partial Differential Equations”, 4th Ed. (2003) by Haberman

“Applied Partial Differential Equations: An Introduction” (2002) by Alan Jeffrey

“Beginning Partial Differential Equations” (2008) by Peter V. O’Neil

“Introduction to the Theory of Fourier Series and Integrals” (1952) by H.S. Carslaw