MATH 219
Introduction to Differential Equations

Frequency: Fall/Spring Terms **Credit:** 4

Catalog description: First order equations and various applications. Higher order linear differential equations. Power series solutions. The Laplace transform. Solutions of initial value problems. Systems of linear differential equations. Introduction to partial differential equations.

Course Objectives: The objectives of this course are to introduce the student with the concept of a differential equation, basic techniques for solving certain classes of differential equations, especially those which are linear, and making connections between the qualitative features of the equation and the solutions. Connections to problems from the physical world are emphasized. As well as ordinary differential equations, the course aims to introduce the student to certain partial differential equations.

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Exams and Grading:
3 Short Exams : 30 %
Midterm Exam: 30 %
Final Exam: 40 %
Bonus : 5% (each instructor will decide independently)

If you miss more than two exams (including short exams) you will get NA.

Textbook: "Elementary Differential Equations and Boundary Value Problems", Boyce, W. E., DiPrima, R. C., 9th ed., (available at the bookstore)

Reference Books:
Ross, S. L. "Differential Equations", 9th ed., John Wiley and sons, New York
Elsgolts, L. "Differential equations and the
Arnold, V. "Ordinary differential equations", MIT Press, 1998

Website: http://math.ncc.metu.edu.tr/math219/

Make-up Policy: In order to be eligible to enter a make-up examination for a missed examination, a student should have a documented or verifiable, and officially acceptable excuse. A student cannot get make-up examinations for two missed exams. The make-up examination for all exams will be after the final exam, and will include all topics.

Math Help Room: The mathematics help room in T-103 is a room staffed by mathematics faculty and teaching assistants where students may gather to ask questions, work on homework, and view exams. *Students are also invited to seek out instructors in their offices.*

The table on the next page is a rough guideline for the content of course lectures. Professors may reorder their lectures as necessary/desired. Section and page numbers below are from the textbook, *Elementary Differential Equations and Boundary Value Problems*, Boyce and DiPrima, 9th ed., 2010.

Week 1: Feb.14-15	1	Introduction, Directional Fields **Chapter 2. First Order Differential Equations** **§2.2:** Separable equations (also homogeneous equations - see p49 #30).
Week 2: Feb.18-22	2	**§2.1:** Linear equations; Method of integrating factors. **§2.3:** Modeling with first order equations (tank problems).
	3	**§2.4:** Differences between linear and nonlinear equations (existence and uniqueness theorems).
	4	**§2.6:** Exact equations and integrating factors.
Week 3: Feb.25-Mar.1	5	**Chapter 7. Systems of First Order Linear Equations** **§7.1:** Introduction. **§7.2:** Review of matrices.
	6	**§7.3:** Systems of linear algebraic equations; Linear independence, eigenvalues, eigenvectors.
Week 4: Mar.4-8	7	**§7.4:** Basic theory of systems of first order linear equations. **§7.5:** Homogeneous linear systems with constant coefficients.
	Short Exam #1 (Covering 2.1-2.6)	
	8	**§7.5:** Homogeneous linear systems with constant coefficients. **§7.6:** Complex eigenvalues.
Week 5: Mar.11-15	9	**§7.7:** Fundamental matrices.
Week 6: Mar.18-22	10	**§7.8:** Repeated eigenvalues. **§7.9:** Nonhomogeneous linear systems (variation of parameters only).
Week 7: Mar.25-29	11	**Chapter 4. Higher Order Linear Equations** **§4.1:** General theory of n^{th} order linear equations.
	Short Exam #2 (Covering 7.1-7.7)	
	12	**§4.2:** Homogeneous equations with constant coefficients.
Week 8: Apr.1-5	13	**Chapter 3. Second Order Linear Equations** **§3.2:** Fundamental solutions of linear homogeneous equations.
	Midterm #1	
	14	**§3.3:** Linear independence and the Wronskian. **§3.4:** Complex roots of the characteristic equation.
Week 9: Apr.8-13	15	**§3.5:** Repeated roots; Reduction of order.
	16	**§3.6:** Nonhomogeneous equations; Method of undetermined coefficients.
Week 10: Apr.15-19	17	**§4.3:** The method of undetermined coefficients.
	18	**§3.7:** Variation of parameters.
Week 11: Apr.22-26	19	**§3.8:** Mechanical and electrical vibrations.
	20	**§3.9:** Forced Vibrations.
Week 12: Apr.29-May. 3	21	**Chapter 6. The Laplace Transform** **§6.1:** Definition of the Laplace transform.
	22	**§6.2:** Solution of initial value problems. **§6.3:** Step functions.
Week 13: May.6-10	23	**§6.4:** Differential equations with discontinuous forcing functions.
	24	**§6.5:** Impulse functions. **§6.6:** The convolution integral.
Week 14: May.13-17	25	**Chapter 10. Partial Differential Equations and Fourier Series** **§10.A:** Derivation of the Heat Conduction Equation. **§10.1:** Two-point boundary value problems.
	Short Exam #3 (Covering 6.1-6.6)	
	26	**§10.2:** Fourier series. **§10.3:** The Fourier convergence theorem.
Week 15: May.20-24	27	**§10.4:** Even and odd functions.
	28	**§10.5:** Separation of variables, heat conduction in a rod.
FINAL EXAM: TBA		