MATH 219 Introduction to Differential Equations

Credit: (4-0) 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: By the end of this course, a student will:

- classify and identify different types of differential equations,
- explicitly solve several important classes of ordinary differential equations and interpret their qualitative behaviour,
- apply ideas from linear algebra in order to solve single linear ordinary differential equations and systems of such equations,
- model certain physical phenomena using differential equations and reinterpret their solutions physically,
- use power series methods to solve second order linear differential equations
- apply the Laplace transform for solving differential equations,
- use the method of separation of variables in order to solve some basic partial differential equations via Fourier series.

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Course Website: http://ma219.math.metu.edu.tr/ and https://metuclass.metu.edu.tr/

Textbook: "Elementary Differential Equations and Boundary Value Problems", Boyce, W. E., DiPrima, R. C., 9th ed.

Exams and Grading:

Midterm 1	: 35 % (8th of April, Saturday, 17:00)
Midterm 2	: 30 % (13th of May, Saturday, 17:00)
Final	: 40 % (to be announced)
Total	: 105 (5 points bonus)

Attendance: Attendance is required. Policy varies from section to section.

Suggested Problems:A list of suggested problems will be announced on the course website. Students are encouraged to attempt to solve all of these problems in a timely manner, and ask the instructors about the ones that they cannot solve. At least 25% of the exam problems will be chosen among these problems.

NA Policy: A student who misses all exams will receive a grade of NA for the course. In addition, a student with weighted average of Midterm 1 and Midterm 2 grades less than 15% will not be eligible to take the final examination and receive a grade of NA from the course (assuming that midterm 1 and 2 grades are M1 and M2 respectively, this condition is $(0.30*M1+0.30*M2)/0.60<15$).

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.

Lectures:

Section, Instructor	Lecture Time and Place	Instructor e-mail, Office (Math building), office phone
S1. Özgür Kişisel	Tue 10:40-12:30 (U3) Fri 8:40-10:30 (U3)	akisisel@metu.edu.tr 128, (312) 210 5388
S2. Semra Pamuk	Mon 10:40-12:30 (G111) Thu 8:40-10:30 (G111)	pasemra@metu.edu.tr 228, (312) 210 2990

Office Hours: To be announced on the website.

Important Dates:

- **February 20:** Classes start
- **February 27-March 3:** Add-drop period
- **April 8:** Midterm 1
- **April 23:** National Sovereignty and Children's Day (Sunday)
- **April 30:** Course withdrawal
- **May 1:** Labor and Solidarity Day (Monday)
- **May 13:** Midterm 2
- **May 19:** Commemoration of Atatürk & Youth and Sports Festival (Friday)
- **May 26:** Classes end
- **May 29-June 9:** Final Exams
- **June 19:** Grades announced

Course Schedule

The table below is a rough guideline for the content of course lectures. Instructors 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.20-24	1	**§1.1, §1.3:** Introduction, Direction Fields **Chapter 2. First Order Differential Equations** **§2.2:** Separable equations (also homogeneous equations - see p49 #30).
	2	**§2.1:** Linear equations; Method of integrating factors.
Week 2: Feb.27-Mar.3	3	**§2.3:** Modeling with first order equations
	4	**§2.4:** Differences between linear and nonlinear equations
Week 3: Mar.6-10	5	**§2.6:** Exact equations and integrating factors.
	6	**Chapter 7. Systems of First Order Linear Equations** **§7.1:** Introduction. **§7.2:** Review of matrices.
Week 4: Mar.13-17	7,8	**§7.3:** Systems of linear algebraic equations; Linear independence, eigenvalues, eigenvectors.
Week 5: Mar.20-24	9	**§7.4:** Basic theory of systems of first order linear equations. **§7.5:** Homogeneous linear systems with constant coefficients.
	10	**§7.6:** Complex eigenvalues.
Week 6: Mar.27-31	11	**§7.7:** Fundamental matrices. **§7.8:** Repeated eigenvalues.
	12	**§7.9:** Nonhomogeneous linear systems (variation of parameters only).
Week 7: Apr.3-7	13	**Chapter 4. Higher Order Linear Equations** **§4.1:** General theory of n^{th} order linear equations
	14	**§4.2:** Homogeneous equations with constant coefficients.

MIDTERM 1 (April 8, Saturday)		
Week 8: Apr.10-14	15	**§4.3:** The method of undetermined coefficients.
	16	**§4.4:** The method of variation of parameters.
Week 9: Apr.17-21	17	**§3.7:** Mechanical and electrical vibrations. **§3.8:** Forced Vibrations.
	18	**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
Week 10: Apr.24-28	19	**§5.4:** Euler Equations, Regular Singular Points
	20	**§5.5:** Series Solutions Near a Regular Singular Point, Part I
Week 11: May.1-5	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.
	Holiday: May 1st , Monday	
Week 12: May.8-12	23	**§6.4:** Differential equations with discontinuous forcing functions.
	24	**§6.5:** Impulse functions. **§6.6:** The convolution integral.
MIDTERM 2 (May 13, Saturday)		
Week 13: May.15-19	25	**Chapter 10. Partial Differential Equations and Fourier Series** **§10.1:** Two-point boundary value problems.
	Holiday: May 19th , Friday	
Week 14: May.22-26	26	**§10.2:** Fourier series. **§10.3:** The Fourier convergence theorem.
	27	**§10.4:** Even and odd functions. **§10.5:** Separation of variables, heat conduction in a rod.
FINAL EXAM (between May 29-June 9)		