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 behavior,
- 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.

Course Coordinator: Özgür Kişisel (Office: 128, Mathematics Department. Phone: (312) 210 5388) akisisel@metu.edu.tr

Course Assistant: E.Ezgi Aladağlı Alptekin (Office: Z-29, Mathematics Department. Phone: (312) 210 5370) aladagli@metu.edu.tr

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

Textbook: "Elementary Differential Equations and Boundary Value Problems", Boyce, W. E., DiPrima, R. C., 10^{th} ed.

Office Hours: To be announced.

Exams and Grading: The grading will be based on two midterm examinations and one final examination.

- **Midterm 1:** 30 % (date to be announced)
- **Midterm 2:** 30 % (date to be announced)
- **Final:** 40 % (date to be announced)

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.

NA Policy: A student who misses all exams will receive a grade of NA for the course.

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.

Instructor	Lecture Times and Places	Instructor e-mail, Office (Math building), office phone
S1. Özcan Yazıcı	Tue 10:40-12:30 (U3), Fri 8:40-10:30 (U3)	oyazici@metu.edu.tr 127, (312) 210 5387
S2. Özgür Kişisel	Mon 10:40-12:30 (YP-A3), Thu 8:40-10:30 (YP-A3)	akisisel@metu.edu.tr 128, (312) 210 5388

Important Dates:

- **February 17:** Classes begin
- **February 24-28:** Add-drop and advisor approvals
- **March 30-April 1:** Religious holiday
- **April 23:** National Sovereignty and Children's Day (Wednesday)
- **April 21-27:** Course withdrawal applications
- **May 1:** Labor and Solidarity Day (Thursday)
- **May 19:** Commemoration of Atatürk & Youth and Sports Festival (Monday)
- **May 30:** Last day of classes
- **June 6-9:** Religious holiday
- **June 11-24:** Final exams period
- **June 30:** The announcement of letter grades

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, 10th ed., 2010.

Week 1: Feb.17-21	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.24-28	3	**§2.3:** Modeling with first order equations
	4	**§2.4:** Differences between linear and nonlinear equations
Week 3: Mar.3-7	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.10-14	7,8	**§7.3:** Systems of linear algebraic equations; Linear independence, eigenvalues, eigenvectors.
Week 5: Mar.17-21	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.24-28	11	**§7.7:** Fundamental matrices. **§7.8:** Repeated eigenvalues.
	12	**§7.9:** Nonhomogeneous linear systems (variation of parameters only).
Week 7: Mar.31-Apr.4	13	**Chapter 4. Higher Order Linear Equations** **§4.1:** General theory of n^{th} order linear equations
Week 8: Apr.7-11	14	**§4.2:** Homogeneous equations with constant coefficients.
	15	**§4.3:** The method of undetermined coefficients.
Week 9: Apr.14-18	16	**§4.4:** The method of variation of parameters.
	17	**§3.7:** Mechanical and electrical vibrations. **§3.8:** Forced Vibrations.

Week 10: Apr.21-25	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
	19	**§5.3:** Series Solutions Near an Ordinary Point, Part II **§5.4:** Euler Equations, Regular Singular Points
Week 11: Apr.28-May.2	20	**§5.5:** Series Solutions Near a Regular Singular Point, Part I
	21	**Chapter 6. The Laplace Transform** **§6.1:** Definition of the Laplace transform.
Week 12: May.5-9	22	**§6.2:** Solution of initial value problems. **§6.3:** Step functions.
	23	**§6.4:** Differential equations with discontinuous forcing functions.
Week 13: May.12-16	24	**§6.5:** Impulse functions. **§6.6:** The convolution integral.
	25	**Chapter 10. Partial Differential Equations and Fourier Series** **§10.1:** Two-point boundary value problems.
Week 14: May.19-23	26	**§10.2:** Fourier series.
Week 15: May.26-30	27	**§10.3:** The Fourier convergence theorem. **§10.4:** Even and odd functions.
	28	**§10.5:** Separation of variables, heat conduction in a rod.