

MATH 255: DIFFERENTIAL EQUATIONS

2026-2027, FALL TERM

Course Syllabus

GENERAL INFORMATION

Section 1	Instructor	Prof. Dr. Nasser Aghazadeh
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Section 2	Instructors	Inst. Dr. Barış Çiçek
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Section 3	Instructor	Dr. Kemal Cem Yılmaz
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Section 4	Instructor	Dr. Tina Beşeri Sevim
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Section 5	Instructor	Dr. Aylin Bozacı Serdal
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WEEKLY SCHEDULE

Monday	Tuesday	Wednesday	Thursday	Friday
	Section 1 13:30-15:15 Prof. Dr. Erdal Saygın Lecture Hall		Section 1 13:30-15:15 Prof. Dr. Erdal Saygın Lecture Hall	
	Section 2 13:30-15:15 Dept. of Mathematics Z-11 Lecture Hall		Section 2 13:30-15:15 Dept. of Mathematics Z-11 Lecture Hall	
	Section 3 13:30-15:15 Dept. of Comp. Eng. Class D5		Section 3 13:30-15:15 Dept. of Comp. Eng. Class D5	
	Section 4 13:30-15:15 Eng. Building C Class B211		Section 4 13:30-15:15 Eng. Building D Class Z40	
	Section 5 13:30-15:15 Faculty of Architecture "Yeni Amfi"		Section 5 13:30-15:15 Faculty of Architecture "Yeni Amfi"	

COURSE DESCRIPTION

A first step to construct a mathematical model that describes a physical phenomenon is to observe and understand the underlying *dynamic* process. Such a process naturally brings along the notion of *rate of change*. Therefore, a way to establish a mathematical model for a dynamic process is to formulate a mathematical relation involving the state of the system and its rate of change. If the process evolves continuously, then a more accurate way to express the rate of change is to take into account the instantaneous rate of change, namely

derivatives. Then, the resulting relation becomes a relation involving the state and its derivatives, called a differential equation.

In this one-semester introductory course, the goal is to introduce fundamental concepts of differential equations to the students. The course mainly covers classification of differential equations, methods for deriving solutions to various class of differential equations or systems of differential equations, examining the behavior of solutions using basic analytical and graphical tools and establishing mathematical models of some basic real-world applications.

LEARNING OUTCOMES

Upon successfully completing this course, it is expected that students have following outcomes:

- Classify differential equations and identify their basic properties and terminology. Interpret first-order differential equations using direction fields.
- Solve first-order ordinary differential equations, including separable, linear, Bernoulli, and exact equations, using appropriate analytical methods.
- Formulate simple mathematical models using first-order differential equations and understand basic existence and uniqueness results.
- Solve second-order homogeneous linear differential equations with constant coefficients, using fundamental concepts such as linear independence, the Wronskian, and the principle of superposition.
- Solve nonhomogeneous second-order linear differential equations using methods such as undetermined coefficients and variation of parameters.
- Model and analyze basic mechanical vibration problems using second-order differential equations.
- Find series solutions of second-order linear differential equations near ordinary points and solve Cauchy–Euler equations.
- Use Laplace transforms to solve initial value problems, including problems involving step functions and discontinuous forcing functions.
- Solve systems of first-order linear differential equations using eigenvalues and eigenvectors, including systems with real and complex eigenvalues, and fundamental matrices.

PREREQUISITES

You should be familiar with the following subjects of first-year calculus courses.

- Limits of single-variable functions
- Derivatives of single-variable functions and differentiation techniques
- Integrals of single-variable functions and integration techniques
- Basic notions of power series
- Partial differentiation

If you are not comfortable with one or more of these topics, it is recommended for you to consult the related sections of first years Calculus course.

COURSE MATERIALS AND RESOURCES

Communication. All announcements will be posted via Microsoft Teams. Please use the code

k5z0104

to enroll our Team Room “*Math 255: Differential Equations, Fall 26-27*” in Microsoft Teams.

Textbooks. Our main textbook is

1. W.E. Boyce and R.C. DiPrima, (2017). *Elementary differential equations and boundary value problems*, 11th edition. John Wiley & Sons Inc., New York.

As a supplementary source, you can use following textbooks:

2. R.K. Nagle, E.B. Staff and A.D. Snider, (2018). *Fundamentals of differential equations*, 9th edition. Pearson, London.
3. S.L. Ross (1984). *Differential equations*, 3rd edition. John Wiley & Sons, Inc., New York.

Electronic Sources. You can use the following set of video lectures that will aid you to improve your learning on differential equations.

4. [Differential Equations - Video Lectures](#)

GRADING POLICY AND EXPECTATIONS

Exams. There will be 2 Midterm Examinations 30% of your total grade each and 1 Final Examination %40 of your total grade. Each exam will be out of 120 points, with +20 bonus points. At least 20 points on each exam will consist of problems taken directly from the assignments (see the WebWork and Suggested Exercises parts below).

If you miss an exam and have an official excuse (such as a valid medical report), you can take the make-up exam. Your grade from the make-up exam will be counted for your missing one. Note that there will be only one make-up exam which will be held at the end of the semester (see Important Dates and Calendar section).

WebWork. Each week we will share a set of homework via [WebWork](#). Completing and submitting your works is not mandatory but it is strongly expected.

Suggested Exercises. In addition to the WebWork assignments, we share a selection of exercises from the main textbook (see Course Outline section), which we strongly recommend you to solve them.

To encourage you to work on these problems, some of the exercises from both WebWork and the Suggested Exercises will appear on the exams exactly as assigned.

Attendance. Attendance at lectures is not mandatory, but it is strongly expected.

Grading. Based on the above criteria, your Total Grade will be evaluated by the following formula:

$$\text{Total Grade} = 30\% \text{ of M-I} + 30\% \text{ of M-II} + 40\% \text{ of F}$$

Your Letter Grade will be evaluated according to your Total Grade. Unless indicated otherwise, evaluation of the letter grades will be based on the catalog system declared in [IZTECH Graduate Education Regulations](#).

Total Grade	90–100	85–89	80–84	75–79	70–74	65–69	60–64	50–59	0–49
Letter Grade	AA	BA	BB	CB	CC	DC	DD	FD	FF

OFFICE HOURS

Tutoring Center schedule will be announced via Microsoft Teams.

IMPORTANT DATES AND CALENDAR

See the following table and the calendar.

Midterm 1	3rd of November (6th week)
Midterm 2	15th of December (12th week)
Final Exam	During the finals week (TBA)
Make-up Exam	25th of January (first Monday after the finals week)

Detailed information will be announced via Microsoft Teams.

September						
S	M	T	W	T	F	S
		01	02	03	04	05
06	07	08	09	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

October						
S	M	T	W	T	F	S
				01	02	03
04	05	06	07	08	09	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

November						
S	M	T	W	T	F	S
01	02	03	04	05	06	07
08	09	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

December						
S	M	T	W	T	F	S
		01	02	03	04	05
06	07	08	09	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

2027

January						
S	M	T	W	T	F	S
					01	02
03	04	05	06	07	08	09
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Lectures
Semester Starts & Ends
Finals Week

Public Holiday
Midterms, Final & Make-up Exam

COURSE OUTLINE

WEEKS	SUBJECTS	SECTIONS IN TEXTBOOK	SUGGESTED EXERCISES
Week 1	Chapter 1: Introduction – Basic concepts, classification – Direction fields	Section 1.1 Section 1.2 Section 1.3	Page 8,9: 3,4,8,9,11-16,23 Page 15: 1,4,5 Page 22: 1-4,6,9
Week 2	Chapter 2: First-Order Differential Equations – Linear equations, method of integration factors – Bernoulli equations (Page 58) – Separable equations	Section 2.1 Section 2.4 (Page 58) Section 2.2	Page 31, 32: 1,4,9,11,18,20,21,23 Page 58: 1,2 Page 38,39: 2,6,8,9,14,19
Week 3	– Homogeneous equations (Page 38-39) – Modeling with first-order equations	Section 2.2 (Page 38,39) Section 2.3	Page 38,39: 23,26, 28,30 Page 47: 1,2, 10, 11, 13, 14
Week 4	– Exact equations and integration factors	Section 2.6	Page 75: 3,4,6,7,12,16,20-22
Week 5	– Existence and uniqueness theorems	Section 2.4	Page 57,58: 1,3,5,7,9,17,21
Week 6	– Midterm 1 Chapter 3: Second-Order Linear Equations – Introduction and general theory: the Wronskian and principle of superposition – Homogeneous equations with constant coefficients: distinct roots of the characteristic equation	Section 3.2 Section 3.1	Page 119: 4,5,6,10,14,20,21 Page 109: 5,6,11,12,16-18,21
Week 7	– Complex roots – Repeated roots; reduction of order	Section 3.3 Section 3.4	Page 125: 3,4,9,10,14,15,18 Page 132: 3,7,11,12,28,29 Page 133: 19, 21, 22
Week 8	– Nonhomogeneous equations – Method of undetermined coefficients	Section 3.5	Page 141: 4,5,8,10,12,13
Week 9	– Variation of parameters – Application to constant coefficient linear equations: mechanical vibrations	Section 3.6 Section 3.7	Page 146: 6-8,11,13,14 Page 157-158: 3,4,18,23
Week 10	Chapter 5: Series Solutions of a Second-Order Linear Equations – Series solution near an ordinary point – Cauchy-Euler equations	Section 5.2 Section 5.4	Page 204: 3,4,7-9,12,13,18 Page 218-219: 3,6,9,17,19,23,27
Week 11	Chapter 6: The Laplace Transform – Definition and properties of the Laplace transform – Solving IVPs by using the Laplace transform	Section 6.1 Section 6.2	Page 247: 1,2,4,7,9,17,19 Page 255: 1,3,4,6,9,12,16
Week 12	– Midterm 2 – Step functions – Discontinuous forcing functions	Section 6.3 Section 6.4	Page 262-263: 1,4-7,14,16,23,27 Page 268: 1,2,6,7
Week 13	– The convolution integral Chapter 7: System of First-Order Linear Equations – Review on linear algebra: matrices, system of algebraic equations, linear independence, eigenvalues and eigenvectors	Section 6.6 Sections 7.2 and 7.3	Page 279: 4,6,7,9,11,12,14,17 Page 284-285: 1,2,4,6 Page 293: 1,2,3 Page 304: 14-17
Week 14	– Basic theory of systems of first-order linear equations – Homogeneous linear systems with constant coefficients: distinct eigenvalues case – Complex eigenvalues	Section 7.4 Section 7.5 Section 7.6	Page 308: 1,2,3 Page 318: 1,2,3,17,18,19 Page 327: 1,2,3,7,8
Week 15	– Fundamental matrices	Section 7.7	Page 336: 1,3,5,9