MATH 255: DIFFERENTIAL EQUATIONS
2025-2026, FALL TERM

Course Syllabus

GENERAL INFORMATION

Section 1	**Instructor**	Prof. Dr. Nasser Aghazadeh
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Section 2	**Instructors**	Asst. Prof. Dr. Bekir Baytaş
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Section 3	**Instructor**	Dr. Kemal Cem Yılmaz
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Section 4	**Instructor**	Prof. Dr. Şirin Atılgan Büyükaşık
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Section 5	**Instructor**	Assoc. Prof. Dr. Gökhan Şahan
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	Address	Office 211, Dept. of Mathematics

WEEKLY SCHEDULE

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

COURSE DESCRIPTION

A first step to construct a mathematical model that describes a physical phenomenon is to observe and understand the *movement* process. A movement action, brings along the notion of *rate of change*. Therefore, a way to establish a mathematical model for a dynamic process is to write a mathematical relation that involves the state and its rate of changes. If the movement is happening continuously, then a better way to express the rate of changes that is more consistent with the reality is to take into account the instantaneous rate of changes, so called derivatives. Then, in this case, 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 give fundamental concepts of differential equations to the students. Content of the course mainly covers classification of differential equations, strategies for deriving solutions to various class of differential equations or systems of differential equations, analyzing them from geometrical point of view 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:

- Be able to identify and classify a differential equation with respect to its order and linearity. Be able to determine whether it is homogeneous or nonhomogeneous.
- Understand that many problems from real world can be modeled by differential equations.
- Be able to develop the slope field for a first-order differential equation to illustrate geometrical view of the general solution.
- Understand importance of existence and uniqueness of a solution to a given initial-value problem.
- Understand that different class of differential equations have different type of solving strategies. Be able to determine and apply appropriate solving strategies to derive an analytical solution for a given differential equation.
- Be able to express a higher-order linear differential equation as a system of first-order differential equations.
- Be able to solve system of first-order differential equations. Be able to analyze asymptotic behaviour of solutions by investigating the associated coefficient matrix of the system of differential equations.
- Be able to use Laplace transform to solve second-order linear differential equations with discontinuous source functions.

Prerequisites

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

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

If you feel inadequate on at least one of these subjects, 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

`3kqe0tu`

to enroll our Team Room "*Math 255: Differential Equations, Fall 25-26*" in Microsoft Teams.

Textbooks. Our main textbook is

1. W.E. Boyce and R.C. Diprima, (2017). *Elementary differential equations and boundary value problems*, 11^{th} 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*, 9^{th} edition. Pearson, London.
3. S.L. Ross (1984). *Differential equations*, 3^{rd} 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 3 Midterm Examinations 20% of your total grade each and 1 Final Examination %40 of your total grade. Each exam will be out of 110 points, where +10 bonus point is from your WebWork homeworks (see 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 Course Outline section).

WebWork. Each week we will share a set of homework via WebWork. Solving these exercises and returning your works are not mandatory but it is strongly expected. To encourage you to do your homeworks, some of those exercises will exactly appear in the exams.

Suggested Exercises. Other than WebWork homeworks, we share some exercises from your main textbook (see Course Outline section), which we recommend you to solve them. The exercises are chosen from the main textbook.

Attendance. Attendance to 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:

Total Grade = 20% of M-I + 20% of M-II + 20% of M-III + 40% of F

Your Letter Grade will be evaluated according to your Total Grade. Unless indicated otherwise, evaluation of the letter grades will 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	30th of October (5th week)
Midterm 2	27th of November (9th week)
Midterm 3	25th of December (13th week)
Final Exam	During the finals week (TBA)
Make-up Exam	26th of January (after 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			

2026

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	New Year
Semester Starts & Ends	Midterms & Make-up Exam
Finals Week	

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 22: 1-4,6,9
Week 2	**Chapter 2: First-Order Differential Equations** – Linear equations, method of integration factors – Bernoulli equations	Section 2.1 Problems section in Section 2.4, page 58	Page 31, 32: 9,11,18,20,21,23 Page 58: 24,25
Week 3	– Separable equations – Equations that can be transformed to separable equations – Modeling with first-order equations	Section 2.2 Problems section in Section 2.2, page 38-39 Section 2.3	Page 38,39: 2,6,8,9,14,19,23,26, 28,30 Page 47: 1,2
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 – **Midterm 1**	Section 2.4	Page 57,58: 1,3,5,7,9,17,21
Week 6	**Chapter 3: Second-Order Linear Equations** – Introduction and general theory – Homogeneous equations with constant coefficients	Section 3.1 Section 3.2 Section 3.3	Page 119: 4,5,6,10,14,20,21 Page 109: 5,6,11,12,16-18,21 Page 125: 3,4,9,10,14,15,18
Week 7	– Homogeneous equations with constant coefficients – Nonhomogeneous equations – Method of undetermined coefficients	Section 3.4 Section 3.5	Page 132: 3,5,7,11,12,28,29 Page 141: 4,5,8,10,12,13
Week 8	– Variation of parameters – Application to constant coefficient linear equations: mechanical vibrations	Section 3.6 Section 3.7 Section 3.8	Page 146: 6-8,11,13,14 Page 157-158: 3,4,18 Page 167-168: 4, 14
Week 9	– Variable coefficient equations – Method of reduction of order – **Midterm II**	Section 3.4	Page 133: 19, 21, 22
Week 10	– Series solutions – Cauchy-Euler equations	Section 5.2 Section 5.3 Section 5.4	Page 204: 3,4,7-9,18 Page 209-210: 8, 17 Page 218-219: 3,6,9,17,19,23,27
Week 11	**Chapter 4: Laplace Transformation** – Definition and properties of Laplace transformation – Solution of initial value problems by using Laplace transform	Section 6.1 Section 6.2	Page 247: 1,2,7,19,17 Page 255: 1,3,4,6,9,12
Week 12	– 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	**Chapter 5: System of Ordinary Differential Equations** – Review on matrices and system of linear equations – **Midterm III**	Section 7.2 Section 7.3	Page 284-285: 1,2,4,6 Page 293: 1,2,3 Page 304: 14-17
Week 14	– Fundamentals on first-order linear equtions – Distinct eigenvalues – 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
Week 15	– Repeated eigenvalues – Fundamental matrices	Section 7.7 Section 7.8	Page 336: 1,3,5 Page 343: 1,2,3,6