Identification	**Subject**	MATH 310, Applied Differential Equations, 6 ECTS
	Department	Mathematics
	Program	Undergraduate
	Term	Fall, 2023
	Instructor	Mammadova Saida Oqtay
	E-mail:	seide.memmedova@physics.science.az, memmedova_seide.fiz@mail.ru
	Phone:	(+994) 70-477-70-10
	Classroom/hours	Wednesday: 13:40-15:10, 15:20-16:50
Prerequisites	*Applied Differential Equations* is a second-year, first-semester course. The prerequisite is Calculus 2.	
Language	English	
Compulsory/Elective	Required	
Required textbooks and course materials	**Core Textbooks:** 1. William E.Boyce and Richard C. DiPrima, Elementary Differential Equations and Boundary Value problems, 10th edition, 2012 **Supplementary book** 2. Dennis G. Zill, Warren S. Wright, and Michael R. Cullen, *Differential Equations with Boundary-Value Problems*, 8th edition, 2013, 673 p.	
Course outline	Applied Differential Equations plays an important role in the understanding of science, engineering, economics, and computer science, among other disciplines. This introductory course covers First Order Differential Equations o Classify a differential equation as linear or nonlinear. o Understand and create a directional field for an arbitrary first-order differential equation. o Determine the order, linearity or nonlinearity, of a differential equation. o Solve first order linear differential equations. o Solve Separable differential equations. o Solve initial value problems. • Numerical Approximations o Use the Euler or tangent line method to find an approximate solution to a linear differential equation. • Higher Order Differential Equations o Solve second order homogenous linear differential equations with constant coefficients including those with complex roots and real roots. o Determine the Fundamental solution set for a linear homogeneous equation. o Calculate the Wronskian. o Use the method of Reduction of order. o Solve nonhomogeneous differential equations using the method of undetermined	

<table>
<tr><td></td><td colspan="3">coefficients.
o Solve nonhomogeneous differential equations using the method of variation of parameters.
• Laplace Transforms
o Use the definition of the Laplace transform to find transforms of simple functions
o Find Laplace transforms of derivatives of functions whose transforms are known
o Find inverse Laplace transforms of various functions.
o Use Laplace transforms to solve ODEs</td></tr>
<tr><td>Course objectives</td><td colspan="3">Some methods of integration of n-th order ordinary differential equations with constant and non-constant coefficients; To find Laplace transform and inverse Laplace transform; To solve differential equations with Laplace transform method; To find eigenvalues and eigenvectors.</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">At the end of the course the students should be able to:
• Classify and identify different types of differential equations,
• Determine if a given function is a solution to a particular differential equation; apply the theorems for existence and uniqueness of solutions to differential equations appropriately;
• Distinguish between
(a) linear and non-linear differential equations;
(b) ordinary and partial differential equations;
(c) homogeneous and non-homogeneous differential equations;
• Solve ordinary differential equations and systems of differential equations using:
(a) Direct integration
(b) Separation of variables
(c) Methods of undetermined coefficients and variation of parameters
and interpret their qualitative behavior,
• Determine particular solutions to differential equations with given initial conditions.
• Analyze real-world problems such as motion of a falling body, compartmental analysis, free and forced vibrations, etc.; use analytic technique to develop a mathematical model, solve the mathematical model and interpret the mathematical results back into the context of the original problem.
• 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,
Apply the Laplace transform for solving differential equations.</td></tr>
<tr><td rowspan="4">Teaching methods</td><td colspan="2">Lecture</td><td>x</td></tr>
<tr><td colspan="2">Group discussion</td><td>x</td></tr>
<tr><td colspan="2">Experiential exercise</td><td>x</td></tr>
<tr><td colspan="2">Course paper</td><td>x</td></tr>
<tr><td rowspan="7">Evaluation</td><td>Methods</td><td>Date/deadlines</td><td>Percentage (%)</td></tr>
<tr><td>Midterm Exam</td><td></td><td>30</td></tr>
<tr><td>Class Participation</td><td></td><td>5</td></tr>
<tr><td>Quizzes</td><td></td><td>20 (2 quizzes)</td></tr>
<tr><td>Activity</td><td></td><td>5</td></tr>
<tr><td>Final Exam</td><td></td><td>40</td></tr>
<tr><td>Total</td><td></td><td>100</td></tr>
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Policy	▪ **Preparation for class** The structure of this course makes your individual study and preparation outside the class extremely important. The lecture material will focus on the major points introduced in the text. Reading the assigned chapters and having some familiarity with them before class will greatly assist your understanding of the lecture. After the lecture, you should study your notes and work relevant problems and cases from the end of the chapter and sample exam questions. Throughout the semester we will also have a large number of review sessions. These review sessions will take place during the regularly scheduled class periods. ▪ **Attendance** Students who do not attend more than 25% of classes will not be allowed to take the exam. ▪ **Quizzes and examinations** Quizzes may be given unannounced throughout the term. There will be no make-up quizzes. ▪ **Withdrawal (pass/fail)** This course strictly follows grading policy of the School of Science and Engineering. Thus, a student is normally expected to achieve a mark of at least 60% to pass. In case of failure, he/she will be required to repeat the course the following term or year. ▪ **Cheating/plagiarism** Cheating or other plagiarism during the Quizzes, Mid-term and Final Examinations will lead to paper cancellation. In this case, the student will automatically get zero (0), without any considerations. ▪ **Professional behavior guidelines** The students shall behave in the way to create favorable academic and professional environment during the class hours. Unauthorized discussions and unethical behavior are strictly prohibited. ▪ **Ethic** Use of any electronic devices is prohibited in the classroom. All devices should be turned off before entering class. This is a university policy and violators will be reprimanded accordingly! Students should not arrive in late to class!

Tentative Schedule

Week	Date/Day (tentative)	Topics	Textbook/ Assignments
1	20.09.23 22.09.23	• Linear Equations; Method of integrating factor • Separable equations	**2.1, 2.2**
2	27.09.23 29.09.23	• Exact equation, integrating factors • Practice	**2.6**
3	04.10.23 06.10.23	• Second Order Linear Equations. Homogeneous equations with constant coefficients • Solutions of linear homogeneous equations; the Wronskian	**3.1, 3.2**
4	11.10.23 13.10.23	• Complex roots of the characteristic equation • Repeated roots; Reduction of order	**3.3, 3.4**

5	18.10.23 20.10.23	• Nonhomogeneous Equations; Method of Undetermined Coefficients • Variation of parameters	**3.5, 3.6**
6	25.10.23 27.10.23	• Homogeneous equations with constant coefficients • The Method of Undetermined Coefficients	**4.2, 4.3**
7	25.10.23 27.10.23	• The method of variation of parameters • Practice	**4.4** **Quiz (10 pts)**
8	01.11.23 03.11.23	• Definition of the Laplace Transform • Solution of Initial Value Problem	**6.1, 6.2**
9	08.11.23 10.11.23	• Holiday • **Midterm Exam**	
10	15.11.23 17.11.23	• Step Functions • Review of Matrices	**6.3, 7.2**
11	22.11.23 24.11.23	• Systems of Linear Algebraic Equations; Linear independence; Eigenvalues; Eigenvectors • Practice	**7.3**
12	29.11.23 01.12.23	• Homogeneous Linear systems with Constant coefficients • Practice	**7.5**
13	06.12.23 08.12.23	• Complex Eigenvalues • Practice	**7.6**
14	13.12.23 15.12.23	• Fundamental Matrices • Practice	**7.7** **Quiz (10 pts)**
15	20.12.23 22.12.23	• Repeated Eigenvalues • Practice	**7.8**
16	27.12.23 29.12.23	• Nonhomogeneous Linear Systems • Practice	**7.9**
	TBA	**Final Exam**	