DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
COURSE INFORMATION

Course Details				
Code	**Academic Year**			**Semester**
MAT201	3			Fall
Title	**T**	**A**	**L**	**ECTS**
Differential Equations	2	2	1	6

Language	German					
Level	**Undergraduate**	**X**	**Graduate**		**Postgraduate**	
Department / Program	Electrical and Electronics Engineering					
Forms of Teaching and Learning	Face-to-Face, Group Study, Individual Study.					
Course Type	**Compulsory**	**X**	**Elective**			
Objectives	Upon successful completion of this course, a student will have comprehensive knowledge of below subjects; - Understand all of the concepts relating to the order and linearity of ODEs, analytic and computational solution methods for ODEs, and the real-world applications of ODEs. - Apply your understanding of the concepts, formulas, and problem solving procedures to thoroughly investigate relevant models. - Explain the concepts of linear systems, ODE solution methods, and related ideas at a fundamental level, as well as how and why we use the solution techniques that we use.					
Content	- First order differential equations - Linear differential equations - Series solutions of second order linear equations - The Laplace transform - First order systems (both linear and nonlinear)					
Prerequisites	None					
Coordinator	DI Dr. Canan Yıldız					
Lecturer(s)	DI Dr. Canan Yıldız					
Assistant(s)	-					
Work Placement	None					
Recommended or Required Reading						
Books / Lecture Notes	- Edwards, C., and D. Penney. Elementary Differential Equations with Boundary Value Problems. 6th ed. Upper Saddle River, NJ: Prentice Hall, 2003.					
Other Sources	- Brannan, James R., and William E. Boyce. Differential equations: An introduction to modern methods and applications. John Wiley & Sons, 2015. - Boyce, William E., Richard C. DiPrima, and Douglas B. Meade. Elementary differential equations. John Wiley & Sons, 2017.					
Additional Course Material						
Documents	-					
Assignments	-					

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
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Exams	-	
Course Composition		
Mathematics und Basic Sciences	50	%
Engineering	-	%
Engineering Design	-	%
Social Sciences	-	%
Educational Sciences	-	%
Natural Sciences	-	%
Health Sciences	-	%
Expert Knowledge	50	%

Assessment

Activity	Count	Percentage (%)
Midterm Exam	1	40
Quiz	-	
Assignments	1	10
Attendance	-	
Recitations	-	
Projects	-	
Final Exam	1	50
	Total	**100**

ECTS Points and Work Load

Activity	Count	Duration	Work Load (Hours)
Lectures	14	2	28
Self-Study	1	66	66
Assignments	10	4	40
Presentation / Seminar Preparation	-		
Midterm Exam	1	3	3
Recitations	14	2	28
Laboratory	-		
Projects	-		
Final Exam	1	3	3
		Total Work Load	**168**
		ECTS Points (Total Work Load / 28)	**6**

Learning Outcomes

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
COURSE INFORMATION

1	Model a simple system to obtain a first order ODE. Visualize solutions using direction fields and approximate them using Euler's method.
2	Solve a first order linear ODE by the method of integrating factors or variation of parameter.
3	Calculate with complex numbers and exponentials.
4	Solve a constant coefficient second order linear initial value problem
5	Compute Fourier coefficients, and find periodic solutions of linear ODEs by means of Fourier series.
6	Solve constant coefficient linear initial value problems using the Laplace transform together with tables of standard values.
7	Calculate eigenvalues, eigenvectors, and matrix exponentials, and use them to solve first order li near systems. Relate first order systems with higher-order ODEs.
8	Recreate the phase portrait of a two-dimensional linear autonomous system from trace and determinant.
9	Determine the qualitative behavior of an autonomous nonlinear two-dimensional system by means of an analysis of behavior near critical points.
Weekly Content	
1	Differential equations, Direction fields, Linear differential equations of first order with variable coefficients, Linear systems of equations; Definition of eigenvector and eigenvalue.
2	Review of complex numbers, Eigen values and eigen vector for matrices, Drawing phase portraits
3	Introduction to non-linear systems, Solutions and phase portraits for defective matrices and Wronskian
4	Similar matrices and matrix exponentials, Rewriting second order ODE as firs t order systems
5	Solving constant coefficient second order ODE, Mechanical vibrations
6	Forced vibrations and undetermined coefficients, Variation of parameters and fundamental matrix
7	Nonlinear ODE: bifurcation phenomenon in autonomous ODE
8	Linearization of systems; competing species, Existence and uniquness theory for ODE
9	Midterm Exam
10	Numerical methods: Euler's method as "connecting the dots" of a direction field, Runge-Kutta methods
11	Introduction to Laplace transform, Properties of Laplace transform
12	Inverse of Laplace transform, Solving ODE using Laplace transform
13	Review of power series, Ordinary points, regular singular and irregular singular points
14	Power series solutions to Airy equation, Fourier series; Even and odd functions
15	Laplace equation on a rectangle, Laplace equation on circle

Contribution of Learning Outcomes to Program Objectives (1-5)

	P1	P2	P3	P4	P5	P6	P7
1	5	5	4			3	1
2	5	5	4			3	1
3	5	5	4			3	1
4	5	5	4			3	1
5	5	5	3			3	1

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
COURSE INFORMATION

6	5	5	3			3	1
7	5	5	3			3	1
8	5	5	3			3	1
9	5	5	3			3	1

Contribution Level	1: Low 2: Low-intermediate 3: Intermediate 4: High 5: Very High
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