DEPARTMENT OF ENERGY SCIENCE AND TECHOLOGIES
COURSE SYLLABUS

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

Language	German					
Level	**Undergraduate**	**X**	**Graduate**		**Postgraduate**	
Department / Program	Energy Science and Technologies					
Forms of Teaching and Learning	Face to face					
Course Type	**Compulsory**	**X**	**Elective**			
Objectives	The students should • understand the essential mathematical concepts of differential equations •have the methodical foundations for the mathematical foundation of natural and engineering sciences, • have a sound knowledge of scientific and mathematical content, principles and methods, • Master basic concepts and techniques and apply them to various (physical) problems. Knowledge & Understanding: 70% Analysis & Methodology: 30%					
Content	• Differential equations 1st order • Linear differential equations of 2nd order, in particular with constant coefficients • Separation solutions • Integrating factor • indefinite coefficients and variation of the constants, • sinusoidal and exponential disturbance functions, • Nonlinear autonomous systems, critical points and phase diagrams • existence and uniqueness, stability • modeling • Numerical and graphical solution methods • systems of linear differential equations; Eigenvalues, eigenvectors, fundamental matrices • Laplace transformation, solution of the linear differential equations with Laplace transformation • Delta function, convolution					
Prerequisites						
Coordinator						
Lecturer(s)	Asist Prof.Dr. Neşe Aral					
Assistant(s)						
Work Placement	No					

Recommended or Required Reading	
Books / Lecture Notes	Şanal Ziya, Mathematik für Ingenieure Papula Lothar, Mathematik für Ingenieure und Naturwissenschaftler, Band 2
Other Sources	Gilbert Strang, Differential Equations and Linear Algebra George Simmons, Differential Equations with Applications and Historical Notes P. Furlan, Das Gelbe Rechenbuch 3

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	Skriptum „Integraltransformationen und partielle Differentialgleichungen für Ingenieure“, Prof. Dr. Dirk Ferus MIT Open Courseware – Differential Equations MIT Mathlets – Interactive Mathematics
Additional Course Material	
Documents	
Assignments	
Exams	

Course Composition		
Mathematics und Basic Sciences		100%
Engineering		%
Engineering Design		%
Social Sciences		%
Educational Sciences		%
Natural Sciences		%
Health Sciences		%
Expert Knowledge		%

Assessment		
Activity	**Count**	**Percentage (%)**
Midterm Exam		30
Quiz		
Assignments		10
Attendance		
Recitations		10
Projects		
Final Exam		50
	Total	**100**

ECTS Points and Work Load			
Activity	**Count**	**Duration**	**Work Load (Hours)**
Lectures	28	1	28
Self-Study	60	1	60
Assignments	1	8	8
Presentation / Seminar Preparation			
Midterm Exam	1	2	2
Recitations	28	1	28
Laboratory	14	1	14
Projects			

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Final Exam	1	2	2
		Total Work Load	**142**
		ECTS Points (Total Work Load / Hours)	**5**

Learning Outcomes	
1	Model a simple, physical system in the form of a first-degree DE.
2	To test the plausibility of a solution of a DE (analyzing extreme cases, graphic analysis, reality check, control of units ...).
3	Visualize solutions of a DE using directional fields and approximate them using the Eulerian method.
4	Find and classify critical points of an autonomous DE, and describe with them the qualitative behavior of the solutions.
5	Know basic types of DEs and use them to model exponential growth / decay, spring-mass systems, LRC circles, etc.
6	Solve DEs with different interfering functions (zero, constant, exponential, sinusoidal, step function, impulse, superpositions of these).
7	Understand and use the following properties of linear systems: Solution, Stability, Transient, Steady State, Phase Response, Amplitude Response, Amplitude Phase Shape, Weight and Transfer Functions, Pole Diagram, Resonance, Fundamental Matrix.
8	Use the following techniques to solve DEs: characteristic equation, exponential response formula, laplace transformation, convolution integral, Fourier series, complex arithmetic, parameter variation, elimination and anti-elimination, matrix eigenvalue method.
9	Know the basic concepts of linearity, superposition, existence, and uniqueness of solutions and use them to solve DEs.

Weekly Content	
1	Intro
2	1. order DE
3	2. Order, const. coeff. LDE
4	Separation of variables
5	Integrating factor
6	undetermined coeff and variation of constants Unbestimmte Koeffizienten und Variation der Konstanten
7	Sine and exponantial forcing functions
8	Nonlinear Autonomous Systems, Critical Points and Phase Diagrams
9	Existence and uniqueness, stability
10	Modeling
11	Numerical and graphical solutions
12	System of LDEs
13	Eigenvalues, eigenvectors, fundamental matrices
14	Laplace transformation, solution of the linear differential equations with Laplace transformation

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Contribution of Learning Outcomes to Program Objectives (1-5)							
	P1	P2	P3	P4	P5	P6	P7
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

Contribution Level	1: Low 2: Low-intermediate 3: Intermediate 4: High 5: Very High
Compiled by:	
Date of Compilation:	