AYDIN ADNAN MENDERES UNIVERSITY
COURSE INFORMATION FORM

Course Title	Introduction to Optimization Theory								
Course Code	MTK648		Couse Level		Third Cycle (Doctorate Degree)				
ECTS Credit	10	Workload	250 *(Hours)*	Theory	3	Practice	0	Laboratory	0
Objectives of the Course	The purpose of this course is to introduce and to understand the significance of optimization theory in view of linear and nonlinear problems. The course also aims to gain the ability of researching using modern approaches in this field in both theoretically and practically.								
Course Content	Overview of optimization, and the required mathematical preliminary for optimization, unconstrained optimization, Local Minimizers, One-Dimensional Search Methods, Steepest Descent Method, Analysis of Gradient Methods, Newton's Method and Levenberg-Marquardt Modification, Newton's Method for Nonlinear Least-Squares Problem, The Conjugate Direction and the Conjugate Gradient Algorithms, The Conjugate Gradient Algorithm for Non-Quadratic Problems, Quasi-Newton Methods, Analysis of Least Squares and Recursive Least Squares Algorithm, Unconstrained Optimization and Neural Networks.								
Work Placement	N/A								
Planned Learning Activities and Teaching Methods	Explanation (Presentation), Discussion, Individual Study, Problem Solving								
Name of Lecturer(s)									

Assessment Methods and Criteria		
Method	Quantity	Percentage (%)
Midterm Examination	1	30
Final Examination	1	50
Assignment	1	20

Recommended or Required Reading	
1	Rangarajan K. Sundaram, A First Course in Optimization Theory, Cambridge University Press, ISBN-13: 978-0521497701, 2013.
2	Edwin K. P. Chong , Stanislaw H. Zak, An Introduction to Optimization, 4th Edition, Wiley, ISBN-13: 978-1118279014, 2008.
3	P. Venkataraman, Applied Optimization with MATLAB Programming, 2nd Edition, Wiley, ISBN-13: 978-0470084885, 2009.

Week	Weekly Detailed Course Contents	
1	Theoretical	Overview of optimization theory and the required mathematical preliminary for optimization
2	Theoretical	Introduction to unconstrained optimization
3	Theoretical	Conditions for Local Minimizers
4	Theoretical	One-Dimensional Search Methods (Golden Search and Fibonacci Search, Newton and Secant Methods)
5	Theoretical	Steepest Descent Method
6	Theoretical	Analysis of Gradient Methods
7	Theoretical	Analysis of Newton's Method and Levenberg-Marquardt Modification
8	Theoretical	Newton's Method for Nonlinear Least-Squares Problem
9	Preparation Work	All subjects covered
	Intermediate Exam	Midterm Exam
10	Theoretical	The Conjugate Direction and the Conjugate Gradient Algorithms
11	Theoretical	The Conjugate Gradient Algorithm for Non-Quadratic Problems
12	Theoretical	Quasi-Newton Method
13	Theoretical	Analysis of Least Squares and Recursive Least Squares Algorithm
14	Theoretical	Unconstrained Optimization and Neural Networks
15	Theoretical	Backpropagation algorithm
16	Theoretical	Final Exam
	Preparation Work	All subjects covered

Workload Calculation				
Activity	Quantity	Preparation	Duration	Total Workload
Lecture - Theory	14	5	3	112

Assignment	2	0	20	40
Midterm Examination	1	44	2	46
Final Examination	1	50	2	52
			Total Workload (Hours)	250
			[Total Workload (Hours) / 25*] = **ECTS**	10
**25 hour workload is accepted as 1 ECTS*				

Learning Outcomes	
1	Ability to understand the importance of optimization for decision making problems
2	Ability to select the best alternative optimization method in the sense of a given objective function
3	Ability to use the optimization methods for artificial intelligence problems
4	Ability to solve unconstrained optimization problems
5	Ability to understand the concepts of convex and non-convex optimization

Programme Outcomes *(Mathematics Doctorate)*	
1	To be able to develop the current and advanced knowledge of mathematics domain to expertise level by an original idea or research, based on the level of its knowledge at the graduate level, and to be able to reach original definitions that will bring innovation to Mathematics.
2	To be able to comprehend the interdisciplinary interaction associated with Mathematics.
3	To be able to use and evaluate the new knowledge in the field of Mathematics with a systematic approach.
4	To be able to develop an idea, a method, a design or an application that will bring innovation to Mathematics, to use well known ideas, methods, designs or applications on a different research area, or to search, comprehend, design, adapt and apply an original subject matter.
5	To be able to criticize, analyze, synthesize and evaluate new and complex ideas.
6	To be able have high-level skills in research methods related to studies on Mathematics.
7	To be able to expand the frontiers knowledge in the field of Mathematics via generating or interpreting an original study, or publishing at least a scientific paper in national/international refereed journals.
8	To be capable of leadership in the positions that require the analyses of problems related to the field of Mathematics.
9	To be able to defend his/her original ideas among the experts in the discussion of math related issues, and to be able to communicate effectively to show his/her competence in the field of Mathematics.
10	To be able to contribute to the solution of the social, scientific, cultural and ethical problems related to the Mathematics, and to be able to support the development of social, scientific, cultural and ethical values.
11	To be able to have both oral and written communication using a foreign language.

Contribution of Learning Outcomes to Programme Outcomes *1:Very Low, 2:Low, 3:Medium, 4:High, 5:Very High*

	L1	L2	L3	L4	L5
P1	4	4	5	4	3
P2	4	4	5	5	
P3	4	4	5	4	3
P4	3	4	5	4	3
P5	3	4	5	4	
P6	4	4	5	4	
P7			3		
P9	3	3	3	3	
P10		3	5	3	
P11	3	3	3		