Content

Course Code	Course Name	Semester	Theory	Practice	Lab	Credit	ECTS
MATH 601	Mathematical Foundations of Machine Learning	1	3	0	0	3	7

Prerequisites	
Admission Requirements	

Language of Instruction	English
Course Type	Elective
Course Level	Doctoral Degree
Objective	To teach students machine learning principles and equip them with focused tools to apply data analysis, manifestations, regression, clustering, and dimensionality reduction techniques.
Content	This course covers the principles of machine learning, focusing particularly on its mathematical foundations. Students will learn fundamental machine learning concepts such as data analysis, regression, classification, clustering, and dimensionality reduction techniques, and will use mathematical tools to apply them.
References	Learning Theory from First Principles, Francis Bach Deep Learning, Ian Goodfellow, Yoshua Bengio and Aaron Courville High-Dimensional Probability, Vershynin Convex Optimization, Boyd ve Vandenberghe Elements of Information Theory, Cover ve Thomas Understanding Machine Learning, Shalev-Shwartz ve Ben-David Pattern Recognition and Machine Learning, Christopher Bishop, Machine Learning: A Probabilistic Perspective, Kevin Murphy

Theory Topics

Week	Weekly Contents
1	Linear Algebra Basics
2	Spectral Theory
3	Singular Value Decomposition
4	Positive Matrices and Perron--Frobenius
5	Calculus Refresher
6	Convex Sets and Functions
7	Convex Optimization
8	Nonconvex Optimization
9	Probability Theory Foundations
10	Concentration Inequalities
11	Advanced Probability for Machine Learning
12	Statistical Estimation
13	High-Dimensional Statistics
14	Information Theory Essentials