Content

Course Code	Course Name	Semester	Theory	Practice	Lab	Credit	ECTS
VM 524	Graph Theory	3	4	0	0	3	8

Prerequisites	
Admission Requirements	

Language of Instruction	English
Course Type	Compulsory
Course Level	Masters Degree
Objective	-The aim of this course is to introduce the fundamental concepts of graph theory and modern network analysis methods, and to enable students to analyze complex real-world network data. Throughout the course, different types of networks such as social networks, information networks, and geographic networks will be studied through modeling, visualization, and interpretation techniques. In addition, students will gain an introductory understanding of Graph Neural Networks (GNNs) as a modern machine learning approach for graph-structured data.
Content	-This course covers the fundamental concepts of graph theory and basic graph algorithms. Students will work with graph analysis using the Python-based library NetworkX. Visualization techniques for networks will be introduced through the software Gephi, and several visualization projects will be carried out on real datasets. During the course, complex network examples such as Wikipedia networks and OpenStreetMap networks will be analyzed. Topics including centrality measures, link prediction methods, and community detection approaches will also be discussed. Finally, the course provides an introduction to Graph Neural Networks (GNNs) and graph-based machine learning methods.
References	Coscia, M. (2025). The Atlas for the Aspiring Network Scientist (2nd ed.).

Theory Topics

Week	Weekly Contents
1	Introduction to Graph Theory and Basic Concepts
2	Graph Representations and Basic Graph Algorithms
3	Introduction to Network Analysis and Real-World Networks
4	Network Analysis with Python: Fundamentals of NetworkX
5	Network Visualization with Gephi
6	Complex Networks: Wikipedia and OpenStreetMap Examples
7	Centrality Measures and Importance Analysis in Networks
8	Midterm
9	Link Prediction Methods
10	Community Detection in Networks
11	Introduction to Graph Neural Networks (GNNs)