

# Department of Basic Sciences—Philadelphia University

## Course Syllabus

Course Title	Graph Theory
Course Code	250352
Semester	Second/2021–2022
Lecturer	Amin Witno
Office Room	403 Nursing Faculty Building
Office Hours	Sun/Tue/Thu: 11–12; Mon/Wed: 11–12
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## Short Description

An introduction to Graph Theory and its applications, covering topics in simple graphs, metrical representations, isomorphism, trees and its applications, spanning trees, Euler and Hamiltonian graphs, bipartite graphs and matching, vertex coloring, planar graphs, with numerous graph algorithms throughout.

## Topics by the Week

1. Definitions and notation, complete graphs, cycles, paths, Euler's theorem on degree, degree sequence, regular graphs.
2. Isomorphism of graphs, subgraphs, self-complementary graphs, connected graphs and bridges.
3. Adjacency matrix, permutation matrix, incidence matrix, degree matrix.
4. Trees and acyclic graphs, spanning trees, the matrix tree theorem.
5. Weight matrix, Kruskal's and Prim's algorithms for minimal spanning tree, depth-first and breadth-first search.
6. Walks in a graph, counting triangles subgraphs, distance and diameters.
7. Distance matrix, distance in weighted graphs, Dijkstra's algorithm.
8. Euler walk and Euler circuit, the Chinese postman problem.
9. Hamilton cycles and Hamiltonian graphs, the traveling salesman problem and solutions for special cases.
10. Bipartite graphs and its coloring algorithm, complete and perfect matching, Hall's theorem.
11. Chromatic number, sequential coloring algorithm, Welsh-Powell coloring algorithm.
12. Planar graphs, proving planarity using Hamilton cycles.
13. Regions of a plane graph, Euler's formula and planarity tests, homeomorphism and Kuratowski's theorem.
14. Maps and the dual graphs, the four-color theorem and proofs of the six and five-color theorems.

## Recommended Textbook

Chapter 5, Topics in Graph Theory, from the book *Discrete Structures in Five Chapters* (2010) CreateSpace. The pdf version of the chapters can be accessed free of charge at the following site.

<http://witno.com/discrete>

## Supporting Material

The outline notes titled *Graph Theory*, also containing the exercise sets, can be downloaded via the link below.

<http://witno.com/philadelphia/notes/won4.pdf>

## Online Resources

The following shortcut will take you to my web homepage at the University, where you find the course syllabus, exam dates, copies of old exams, links to the above materials, and any important announcement related to the current semester.

<http://phi.witno.com>

## Grade Distribution

The following guideline may be modified as necessary according to the developments of Covid-19 situation this semester.

Homeworks	
Quizzes	30%
Class participation	
Midterm Exam	30%
Final Exam	40%

## Exam Dates

Exam dates, once determined, will be posted online at the homepage as well as at the University student-portal page.

## Homework Sets

Homework problem sets with check answers can be downloaded also from the above homepage.