Course unit title:	Graph Theory
Course unit code:	CSC403
Type of course unit: **(Compulsory/optional)**	Optional
Level of course unit: **(First, second or third cycle)**	Bachelor (1st cycle)
Year of study:	4
Semester when the unit is delivered:	7 or 8
Number of ECTS credits allocated:	6
Name of lecturer(s):	TBA

Learning outcomes of the course unit:

Upon succesful completion of this course students should be able to:

- Model problems in computer science using graphs and trees.
- Describe precise and accurate mathematical definitions of objects in graph theory;
- Validate and critically assess a mathematical, graph-theoretical proof;
- Formulate mathematical, graph-theoretical proofs based on definitions;
- Write about graph theory in a coherent and technically accurate manner.

Mode of delivery:	Face- to- face
Prerequisites and co-requisites:	CSC401
Recommended optional program components:	None

Course Contents:

Objective:
The course objective is to provide an introduction to the theory of graphs. The course starts from basic definitions and examples and moves to cover a broad range of topics. Applications of Graph Theory in Computer Science will be discussed throughout. Emphasis will be given to reading, understanding and developing graph theoretical proofs. Topics include: degrees, paths, trees, cycles, Eulerian circuits, bipartite graphs, extremality, matchings, connectivity, network flows, vertex and edge colorings, Hamiltonian cycles and planarity.

Description:

Introduction: What is graph theory useful for? Examples of graphs—directed, undirected, acyclic, complete, bipartite. Incidence and adjacency. Example application: shortest path problem. Example application: three houses problem. Example application: matching jobs to applicants. Directed graphs ,Orientations of an undirected graph, Tournaments, Euler tours in digraphs, Application: rotational position sensor, Into to graphical models.

Trees, Application: planning an efficient road network. Definition of trees. Properties of trees: number of edges and vertices, degree of vertices, cut edges. Spanning trees. Kruskal's algorithm.

Connectivity, Cayley's formula, Cut vertices, vertex cuts, edge cuts. Blocks; the block detection algorithm challenge. Connectivity and edge-connectivity. Application: designing resilient computer networks.

Euler tours and Chinese postmen The seven bridges of Königsberg Conditions for Eulerian graphs. The Chinese postman problem, Fleury's algorithm, Hamilton paths.

Matchings and coverings, Matches, perfect matches, matches in bipartite graphs, Personnel assigment problem, Hall's theorem. The marriage theorem. The Gale-Shapley algorithm.

Connectivity and Paths, Cuts and Connectivity, k-connected Graphs, Network Flow Problems

Graph Coloring, Vertex Colorings, Upper Bounds, Brooks' Theorem, k-chromatic Graphs, Perfect Graphs.

Edges and Cycles, Line Graphs and Edge-coloring, Proper colourings, edge chromaticity. Hamiltonian Cycles

Planar Graphs, Embeddings and Euler's Formula, Drawings in the Plane, Dual Graphs, Characterization of Planar Graphs, Parameters of Planarity

Recommended or required reading:	Douglas B West, Introduction To Graph Theory, 2nd edition, Prentice Hall, 2001. Robin J. Wilson, John J. Watkins : Graphs: An Introductory Approach, Wiley Publishers, 1990. Reinhard Diestel, Graph Theory (1st, 2nd or 3rd edition). Springer-Verlag (1997, 2000, 2005). J. A. Bondy and U. S. R. Murty, Graph Theory with Applications , 1976. B. Bollobás. Modern Graph Theory. Spring GTM 184 New York 1998.

Planned learning activities and teaching methods:	Class Instruction 42 Hours Consultation/Computer Lab 30 Hours
Assessment methods and criteria:	Examinations 70% Assignments/ Class Participation 30% 100%
Language of instruction:	English
Work placement(s):	No
Place of Teaching:	Theoretical Part: Regular Classroom European University Cyprus, Nicosia Practical Part: Computer Laboratory European University Cyprus, Nicosia