<table>
<tr><td>Course Title</td><td colspan="5">Graph Theory and Applications in Networks</td></tr>
<tr><td>Course Code</td><td colspan="5">CSE414</td></tr>
<tr><td>Course Type</td><td colspan="5">Elective</td></tr>
<tr><td>Level</td><td colspan="5">Bachelor (1st Cycle)</td></tr>
<tr><td>Year / Semester</td><td colspan="5">4th Year / 8nd Semester</td></tr>
<tr><td>Teacher’s Name</td><td colspan="5">TBA</td></tr>
<tr><td>ECTS</td><td>6</td><td>Lectures / week</td><td>3 hours / 14 weeks</td><td>Laboratories / week</td><td>N/A</td></tr>
<tr><td>Course Purpose and Objectives</td><td colspan="5">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.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">Upon successful completion of the course, students will 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.</td></tr>
<tr><td>Prerequisites</td><td colspan="2">CSE400</td><td>Co-requisites</td><td colspan="2">None</td></tr>
<tr><td>Course Content</td><td colspan="5">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.</td></tr>
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	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
Teaching Methodology	Face- to- face
Bibliography	Douglas B West, Introduction To Graph Theory, 2nd edition, Prentice Hall. Geir Agnarsson, Graph Theory: Modeling, Applications, and Algorithms, Pearson. Raymond Greenlaw,Robin J. Wilson, Introduction to Graph Theory, Pearson. Reinhard Diestel, Graph Theory. Springer-Verlag.

	Graph Theory with Applications to Engineering and Computer Science, Dover publications.
Assessment	Mid – Term Examination 30% Final Examination 45% Assignments/Lab 15% Class Participation and attendance 10% 100%
Language	English