אוניברסיטת בר-אילן

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Graph Theory with Engineering Applications

83-652

Shmuel wimer

Course format: Lectures

Second Semester **Weekly hours**: 2 lecture + 1 practice

1) **Course objectives**:

To provide advanced undergraduate and graduate students with Graph Theory "state of mind", in facing engineering problems. Acquiring Graph Theory knowledge and experiencing solutions to some common problems will direct the students to analytical approach in their research, in addition to simulation and experiments.

The content comprises both theory and applications. There will be formal proofs of some important theorems (though few), while others will be quoted and their proof will only be overviewed. Algorithms and complexity will only be briefly discussed as those are widely covered in other courses. Each of the topics will demonstrate related practical problems.

2) **Course content**:

Week	Topic	Reading
1	**Introduction:** representations, isomorphism, graph structures, trees, flows, connectivity, transitivity, 3-connected graphs.	
2-3	**Matching:** maximum matching, bipartite graphs, perfect matching, matching algorithms.	
4-5	**Graph coloring:** vertex coloring, the chromatic number, perfect graphs, map coloring, edge coloring.	
6-7	**Connectivity**: vertex connectivity, edge connectivity, 3-connected graphs.	
8-9	**The probabilistic method:** random graphs, expectation, variance, evolution of random graphs.	
10-11	**Planar graphs:** Jordan curve, duality, Euler formula, bridges, planarity recognition, the four-color problem.	
12-13	**Graphs and Matrices:** adjacency and incidence,	

	eigenvectors, ranks, symmetric graphs.	
14	**Cliques and stable sets.**	

3) **Prerequisites:**

Undergrad; Set theory and logic 83109 + Probability and statistics introduction 832016. Graduate: none.

4) **Course requirements:**

Homework assignments. Submission is not mandatory but highly recommended.

Final exam.

5) **Grading:**

Final exam: 100% ; Homework exercises: 0% ; Pass grade (60%) in the final exam is mandatory.

6) **Textbooks and supplementary reading:**

1. J.A. Bondy and U.S.R. Murty, Graph Theory, Springer.
2. D.B. West, Introduction to Graph Theory, Prectice-Hall.