Introduction to Computer Science 2
and
Combinatorics and Graph Theory 1

Syllabus 2025 Spring

1. (February 10.) Fundamental notions of graph theory: graph, simple graph, degree, subgraph, complement, isomorphism, directed graph.
2. (February 17.) Fundamental notions of graph theory, cont'd: walk, trail, path, ciruit, cycle, connected graph, (connected) component, tree, spanning tree.
3. (February 24.) BFS. Minimum weight spanning trees, Kruskal's algorithm.
4. (March 3.) Euler trails and circuits, necessary and sufficient condition for their existence. Hamilton paths and cycles, necessary and (separate) sufficient conditions for their existence.
5. (March 10.) Bipartite graphs, their characterisation. Vertex coloring, lower and upper bounds on the chromatic number, greedy coloring.
6. (March 17.) Zykov's construction. Interval graphs, their coloring.
7. (March 24.) Matchings, independent verices, vertex- and edge cover, their relations. Gallai's theorems. Augmenting path algorithm in bipartite graphs.
8. (March 31.) Matchings (cont'd): Theorems of König, Hall and Frobenius.
9. (April 7.) Edge-chromatic number, theorems of Vizing, Kőnig and Shannon.
10. (April 14.) Flows in networks, st-cut, augmenting path algorithm. Max flow-mincut theorem.
11. (April 28.) Flows (cont'd): Edmonds-Karp theorem, integrality lemma. Generalisations of flows.
12. (May 5.) Menger's theorems.

    The midterm is on May 5th (?), up to the end of flows.
13. (May 12.) Higher connectivity of graphs.
14. (May 19.) Shortest paths, the Bellman-Ford algorithm.