Operations Research Exam Topics, Autumn 2019

1. Breadth First Search, Depth First Search, Shortest paths, Dijkstra's algorithm for finding shortest paths (Schrijver 1.1, Rothvoss 3.1)
2. Longest paths in acyclic digraphs, PERT (Schrijver Application 1.4, `http://cs.bme.hu/thalg/dagpaths.pdf`)
3. Conservative costs, feasible potential. Bellman-Ford algorithm (Schrijver 1.3, Rothvoss 3.2-3.3)
4. Minimum cost spanning trees (Schrijver 1.4, Rothvoss 2)
5. Maximum matching in bipartite graphs, Kőnig's Theorem, Hall's Theorem, perfect matchings in regular bipartite graphs (Schrijver 3.2-3.4, Rothvoss 4.4)
6. Minimum weight perfect matching in bipartite graphs (Schrijver 3.5)
7. Max Flow Min Cut Theorem, Ford-Fulkerson algorithm for maximum flow, the Transportation Problem (Schrijver 4.2, 4.3, Theorem 4.4, Rothvoss 4.1-4.3)
8. Solvability of a system of linear equations. Linear programming problem in standard form. Basic solutions, feasible bases, canonical form with respect to a feasible basis (Ahmed 1.2)
9. Optimality conditions, the simplex method. (Ahmed 1.3, `http://pi.math.cornell.edu/~web401/matt.simplex.pdf`)
10. Farkas Lemma, Duality Theorem (Schrijver 2.3, 2.4)

Knowledge of the following is required to pass the exam:

Basic notions shortest path tree, conservative cost function, spanning tree, matching, flow, linear programming problem, basic solution

Algorithms longest path in acyclic digraph, Dijkstra, Bellman-Ford, Kruskal's algorithm for min cost spanning tree, Kőnig's algorithm for maximum matching in bipartite graph, Ford-Fulkerson algorithm for max flow, simplex algorithm

Theorems Gallai's theorem on feasible potentials, Kőnig's and Hall's theorems on matchings, Max-flow min-cut theorem, Farkas Lemma, Strong Duality Theorem

List of resources referred above (these do not cover the topics exactly the same way as the lectures)

- A. Schrijver, A Course in Combinatorial Optimization, `https://homepages.cwi.nl/~lex/files/dict.pdf`
- S. Ahmed, Linear Programming: Geometry, Algebra and the Simplex Method, `https://www2.isye.gatech.edu/~sahmed/isye3133b/simplex`
- T. Rothvoss, Discrete Optimization, `https://sites.math.washington.edu/~rothvoss/409-spring-2015/DisOpt409-Spring2015.pdf`