Operations Research Exam Topics, Autumn 2019

1. Solvability of a system of linear equations. Linear programming problem in standard form. Farkas Lemma, Duality Theorem. Example: assignment problem. (Schrijver Chapter 2)
2. Integer programming and mixed integer programming problems. Modeling tricks: non-linear objective function, logical relations. Example: facility location problem, traveling salesman problem, knapsack problem.
3. Basic solutions, feasible bases, canonical form with respect to a feasible basis (Ahmed 1.1-1.2)
4. Optimality conditions, the simplex method. (Ahmed 1.3, `http://pi.math.cornell.edu/~web401/matt.simplex.pdf`)
5. The Branch and Bound algorithm (Rothvoss chapter 7)
6. Dynamic programming: the knapsack problem, maximum weight independent set in trees
7. Cheapest paths in acyclic directed graphs, the PERT method (Schrijver Application 1.4, `http://cs.bme.hu/thalg/dagpaths.pdf`)
8. Dijkstra's algorithm. Max Flow Min Cut Theorem, Ford-Fulkerson algorithm for maximum flow (Schrijver Chapter 1, 4.2-4.3, Rothvoss 4.1-4.2)

Knowledge of the following is required to pass the exam:

Basic notions linear programming problem, dual linear program, mixed integer programming problem, LP relaxation, feasible basis, basic solution, optimal basis, cheapest path tree, matching, network flow

Algorithms simplex algorithm, branch and bound, dynamic programming algorithm for the knapsack problem, longest path in acyclic digraph, Dijkstra's algorithm, Ford-Fulkerson algorithm for max flow

Theorems Farkas Lemma, Strong Duality Theorem, Finiteness and optimality of the Branch and Bound algorithm, Max-flow min-cut 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`