MA515 Final Exam Topics

You should be familiar with all of the definitions, examples, theorems, etc. But here are the specific theorems that you should know the proofs for, and the specific algorithms that you should be able to carry out.

- Theorems and Proofs
  1. From my notes
     (a) Theorems 3.15 (Carathéodory), 3.32 (H-Polytopes are V-Polytopes, Minkowski), and 3.36 (V-Polytopes are H-Polytopes, Weyl)
     (b) Theorems of the Alternatives, Theorems 7.2 and 7.3
     (c) Weak Duality, Theorem 9.1
     (d) Duality, Theorem 9.11
     (e) Complementary Slackness, Theorem 9.16, Corollaries 9.17, 9.18
  2. From the book
     (a) Weyl's Theorem for Polytopes, p. 11
     (b) Minkowski's Theorem for Polytopes, p. 30
     (c) Unimodularity Implies Integrality, p. 41
     (d) Circuit Elimination, p. 52
     (e) Greedy Optimality for Matroids, p. 57
     (f) Validity of Dijkstra's Algorithm, pp. 79–81 or my proof.
     (g) Matroid Intersection Duality Theorem, p. 99
     (h) Berge's Theorem, p. 107
     (i) Matching Duality Theorem, p. 113
     (j) König's Theorem, p. 44. You should be able to prove this three different ways: using total unimodularity, matroid intersection, or the max cardinality matching algorithm.
- Algorithms
  1. From my notes
     (a) Fourier Motzkin Elimination
     (b) Be able to write the dual of a general linear program
     (c) Simplex Method

(d) Revised Simplex Method

2. From the book
   (a) Greedy Algorithm, Section 1.4
   (b) Be able to write down the inequalities for the Matroid Polytope, p. 67
   (c) Bellman-Ford, Floyd-Warshall, and Dijkstra's Algorithm, Sections 2.1–2.3
   (d) Matroid Intersection Algorithm, Section 3.2
   (e) Be able to write down the inequalities for the Two Matroid Intersection Polytope, p. 103
   (f) Be able to write down the inequalities for the Matching Polytope, p. 109
   (g) Maximum Cardinality Matching Algorithm, Section 4.3