Lang, Chapters I-IV

Chapter I - Groups

1. Monoids: minors things. 10 minutes.
2. Groups: simple things, examples, subgroups, homomorphisms, kernels and injectivity, HK for commuting H and K, cosets and indexes, the symmetric group. 40 minutes.
3. Normal Subgroups: normality, normalizer, centralizer, quotients, the isomorphism theorem by diagram chasing, solvability and subgroups and quotient groups, the butterfly lemma, Schreier's lemma, Jordan-Hölder. 2 hours.
4. Cyclic Groups: basic properties. 25 minutes.
5. Operations of a Group on a Set: definition, conjugation, translation, conjugate subgroups, the orbit decomposition formula and the class formula, the symmetric and the alternating group, simplicity on A_n. 60 minutes.
6. Sylow Subgroups: the various Sylow theorems, the pq examples. 2 hours.
7. Direct Sums and Free Abelian Groups: direct sums and the universal property, free Abelian groups, subgroups thereof, ranks. 30 minutes.
8. Finitely Generated Abelian Groups: statement and proof. 60 minutes.
9. The Dual Group: … 30 minutes.
10. Inverse Limit and Completion: … 30 minutes.
11. Categories and Functors: definitions, universal objects, products and coproducts, fiber products and coproducts and pull-backs and push-outs, representation functors, natural transformations. 90 minutes.
12. Free Groups: generators and relations, … 90 minutes.

Chapter II - Rings

1. Rings and Homomorphisms: definitions, examples, ideals, generators, principal ideals, homomorphisms, images, kernels, quotients, products, integral domains / entire rings. 60 minutes.
2. Commutative Rings: