Comprehensive Exam Syllabus

Athena Sparks

1. Computability Theory

    - Automata and regular languages
    - Deterministic and non-deterministic Turing machines
    - Halting problem
    - Rice's Theorem
    - Partial recursive functions, recursively enumerable sets
    - Arithmetical hierarchy
    - Turing degrees
    - Jump operator
    - Friedberg-Muchnik Theorem
    - Time and space complexity (LOGSPACE, NL, P, NP, coNP, PSPACE, EXPTIME)
    - NP-completeness of SAT
    - Savitch's Theorem

2. Model Theory

    - Compactness theorem; proof using ultraproducts
    - Lowenheim-Skolem theorems
    - Diagrams
    - Types
    - Existence of κ-saturated structures
    - κ-categoricity
    - The Los-Vaught test
    - Elimination of quantifier arguments
    - Ehrenfeucht-Fraisse method

3. Group Theory

    - Semidirect Product
    - Wreath Product
    - Fitting Subgroup
    - Frattini Subgroup
    - Subnormal Subgroup
    - Nilpotent Groups
    - Schur-Zassenhaus Theorem
    - Hall's Theorems
    - Glauberman's Lemma and Coprime Actions
    - The Transfer
    - Burnside's Normal Complement Theorem
    - Groups with Cyclic Sylow Subgroups
    - Frobenius Groups
    - Primitive Permutation Groups
    - Jordan's Theorem
    - The Simplicity of $\mathrm{PSL}(n, q)$
    - Burnside's Theorem on 2-transitive groups