Oral Examination Syllabus for Eugene So

Major Topic: Homotopy Theory

**Fundamental Groups**
Van Kampen Theorem, Covering Spaces

**Homology/Cohomology**
Singular, Cellular, Simplicial Homology
Excision, Mayer-Vietoris, Cofibrations
Cup and Cap Products, Künneth Formula
Poincaré Duality, Alexander Duality
Universal Coefficient Theorem
Spectral Sequences

**Homotopy Groups**
Whitehead’s Theorem, Hurewicz Theorem, CW-Approximation, Cellular Approximation
Eilenberg-MacLane Spaces, Freudenthal Suspension Theorem, Postnikov Towers
Brown Representability

**Fiber Bundles and Fibrations**
Replacement by Fibrations, Homotopy Sequence of a Fibration
Homotopy Extension and Lifting Theorem
Classification of Fiber Bundles
Characteristic Classes

**Simplicial Theory**
Geometric Realization, Singular Simplicial Complex, Kan Complexes
Simplicial Homotopy Groups, Dold-Kan Correspondence, Eilenberg-Zilber Theorem

**Model Categories**
Definition, Homotopy Category, Fundamental Theorem, Examples, Small Object Argument

**Texts**
*Algebraic Topology* (Hatcher)
*A Concise Course in Algebraic Topology* (May)
*An Introduction to Homological Algebra* (Weibel)
*Simplicial Objects in Algebraic Topology* (May)
*Model Categories* (Hovey)
Minor Topic: Complex Algebraic Geometry

**Complex Geometry** (Griffiths and Harris, Ch. 0.1-2, 0.4-7, 1.1-4)
Complex, Kähler Manifolds
Hodge, Lefschetz Decomposition
Holomorphic Vector Bundles, Line Bundles
Kodaira Vanishing, Kodaira Embedding

**Riemann-Roch, Abel’s Theorem** (Miranda, Ch. V-VIII)
Divisors, Embeddings, Abel-Jacobi Map
Riemann-Roch, Geometric Riemann-Roch, Abel’s Theorem

**Cohomology** (Griffiths and Harris, Ch. 0.3, 1.1; Miranda, Ch. IX)
De Rham, Dolbeaut, Čech Cohomology
De Rham Theorem, Dolbeaut Theorem
Chern Classes

**Texts**
*Principles of Algebraic Geometry* (Griffiths and Harris)
*Algebraic Curves and Riemann Surfaces* (Miranda)