Syllabus of the Oral Test

Nan Li

September 23, 2006

Riemannian Geometry

Manifolds, Differential Structure
Riemannian Metrics
Levi-Civita Connection
Parallel Transportation
Sectional Curvature, Ricci Curvature

Geodesics, Exponential Map, Gauss Lemma
Hopf-Rinow Theorem
First and Second Variations
Jacobi Fields

Manifolds with Constant Sectional Curvature
Cartan-Hadamard Theorem
Bonnet-Myers Theorem

Comparison Geometry
Metric and Hession Comparison
Toponogov Theorem

The Gromov-Hausdorff Distance and some examples
Gromov-Hausdorff Convergence

Reference
Karsten Grove, Riemannian Geometry: A Metric Entrance
Peter Petersen, Riemannian Geometry

Algebraic Topology

The Fundamental Group
The Seifert-Van Kampen Theorem

Homology
Exact Sequence and Excision
Cellular Homology
Mayer-Vietoris Sequence

Cohomology
Künneth Formula
Cup and Cap Products
Poincare Duality

Vector Bundles and Their Characteristic Classes
Stiefel-Whitney Classes
Euler Classes

Reference
Allen Hatcher, Algebraic Topology
John Milnor, Characteristic Class