Syllabus for Oral Examination
Tian Yang (May, 1st, 2009)

Algebraic and Differential Topology

The Fundamental Group
The Seifert-Van Kampen Theorem
Covering Spaces
Lifting properties
Classification of covering spaces
Deck Transformations and group actions

Simplicial homology
Singular homology
Homotopy Invariance
Exact Sequence and Excision
Cellular Homology
Mayer-Vietoris Sequence

Cohomology ring
Künneth formula
Cup and Cap Products
Poincare Duality

Smooth Manifolds
Tangent and Cotangent Spaces
Differential Forms
Operators on Differential Forms:
Contractions, Lie-derivatives and Exterior Differentials
de Rham Cohomology

Reference
Allen Hatcher, Algebraic Topology
James Vick, Homology Theory: An Introduction to Algebraic Topology
John Lee, Smooth Manifolds

Riemannian Geometry

Riemannian metrics
Levi-Civita connection
Parallel translation
Curvature tensor
Sectional curvature, Ricci curvature, Scalar curvature

Geodesic, Exponential map, Gauss lemma
Reimannian manifolds as metric spaces
Hopf-Rinow theorem
First and second variations of arc length
Jacobi fields

Manifolds with constant sectional curvature
Cartan-Hadamard theorem
Bonnet-Myers theorem

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