Syllabus for Oral Qualifying Exam
James Dibble

Major Topic: Differential and Riemannian Geometry

Differential geometry
    Smooth manifolds
    Vector bundles
    Lie brackets and derivatives
    Submersions, immersions, and embeddings
    Integration and Stokes's Theorem
    de Rham cohomology
        de Rham Theorem
        Poincaré duality

Riemannian geometry
    Riemannian metrics
    First and second variation formulas
    Levi-Civita connection
    Geodesics and the exponential map
        Gauss Lemma
        Hopf-Rinow Theorem
    Jacobi fields
    Parallel transport
    Gauss-Bonnet Theorem
    Comparison geometry
        Spaces of constant sectional curvature
        Comparison estimates
        Conjugate points
        Cartan-Hadamard Theorem
        Preissmann's Theorem
        Bonnet-Myers Theorem
        Synge's Theorem

References:
Lee, John. *Introduction to Smooth Manifolds.*
Lee, John. *Riemannian Manifolds: An Introduction to Curvature.*
Petersen, Peter. *Riemannian Geometry.*

Minor Topic: Algebraic Topology

Fundamental group
    Homotopy invariance
    Seifert-Van Kampen Theorem

Covering spaces
    Lifting properties
    Deck transformations
    Classifications

Singular homology and cohomology
    Degree of a map
    Euler characteristic
    Exact sequences and excision
    Mayer-Vietoris sequence

References:
Lee, John. *Introduction to Topological Manifolds.*
Hatcher, Allen. *Algebraic Topology.*