Oral Qualifying Examination Syllabus

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April 3, 2014

1 Algebraic Topology

- Fundamental Group

  - Seifert-van Kampen theorem
  - Covering Spaces
  - *Application(s)*
    * Fundemental Theorem of Algebra
    * Picard's Little Theorem

- Homology

  - Simplicial, Singular, and Cellular Homology
  - Eilenberg Steenrod Axioms
  - Mayer-Vietoris Long Exact Sequence
  - Universal Coefficients for Homology
  - *Application(s)*
    * Leftshetz Fixed Point Theorem

- Cohomology

  - Simplicial, Singular, and Cellular Cohomology
  - Universal Coefficient Theorem
  - Cup and Cap Products
  - Künneth Formula
  - Orientation and Duality

2 Functional Analysis

- Banach Spaces

  - Hahn-Banach Theorem
  - Open Mapping Theorem and Closed Graph Theorem
  - Weak topology and weak* topology
  - Banach Alaoglu Theorem

- Locally and Uniformly Convex Spaces

  - Seminorms and Minkowski functionals
  - Krein Milman Theorem
  - *Application(s)*
    * Stone Weierstrass Theorem

- Bounded Linear Operators

  - Fredholm Operators
  - Compact Operators
  - Measures of Noncompactness
  - Spectrum of Linear Operators
  - Functional Calculus

- Fixed Point Theorems

  - Tychonoff Fixed Point Theorem
  - Schauder Fixed Point Theorem
  - *Application(s)*
    * Peano Existence Theorem for ODEs

References

[Hat01] Allen Hatcher. *Algebraic Topology*. Cambridge University Press, 2001.

[Lax02] Peter Lax. *Functional analysis*. Pure and applied mathematics. Wiley-Interscience, 2002.