

# 1 Major Topic: Topological Degree Theory

1. Topological Degree in Finite Dimensions
  - (a) Uniqueness of the Degree
  - (b) Construction of the Degree
  - (c) Further Properties, including Brouwer's Fixed Point Theorem
  - (d) Borsuk's Theorem
  - (e) The Product Formula, Jordan's Separation Theorem
  - (f) Generalizations and Hopf's Theorem
2. Topological Degree in Infinite Dimensions
  - (a) Basic Facts about Banach Spaces
  - (b) Compact Maps
  - (c) Set Contractions
  - (d) Generalizations to Locally Convex Spaces

# 2 Minor Topic: Lie Algebras

1. Basic Concepts and Definitions
  - (a) Definitions and Standard Examples
  - (b) Ideals and Homomorphisms
  - (c) Solvable and Nilpotent Lie Algebras
2. Semisimple Lie Algebras
  - (a) Theorems of Lie and Cartan
  - (b) Killing Form
  - (c) Complete Reducibility of Representations
  - (d) Representations of  $\mathfrak{sl}_2(\mathbb{F})$
  - (e) Root Space Decomposition

### 3 References

1. Deimling, Klaus. *Nonlinear Functional Analysis*. Berlin: Springer-Verlag, 1985. [Chapters 1, 2].
2. Humphreys, James. *Introduction to Lie Algebras and Representation Theory*. New York: Springer-Verlag, 1972. [Chapters 1, 2].