

# Nonlinear Analysis

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This is a two-day short course in Nonlinear Analysis. On each day, there will be a problem session after the lecture.

The course is an introduction to the theory of nonlinear operators in Banach spaces. Special attention will be given to topological degree theories. Basic knowledge of Sobolev spaces will be very useful.

## Table of Content

1. **Linearization**
  - a. Differential Calculus in Banach Spaces
  - b. Implicit Function Theorem and Continuity Method
  - c. Lyapunov-Schmidt Reduction and Bifurcation
  - d. Hard Implicit Function Theorem
2. **Nonlinear Operators**
  - a. Compact Operators
  - b. Measures of Non-compactness and Set-contractions
  - c. Maximal Monotone and Accretive Operators
  - d. Nemitsky Operators
3. **Topological Degree Theories**
  - a. Brouwer Degree
  - b. Lerray-Schauder Degree
  - c. The Global Bifurcation
  - d. Applications of Degree Theories
4. **The Hille–Yosida Theorem**
  - a. Solution of the Evolution Problem  $du/dt + Au = 0$ ; Existence and Uniqueness
  - b. Regularity
  - c. Self-adjoint case

## References:

1. K. Chang, *Methods in Nonlinear Analysis*, Springer, 2005
2. Z. Denkowski, S. Migorski, N. Papageorgiou, *An Introduction to Nonlinear Analysis*, Kluwer Academic Publishers, New York, 2003
3. Pavel Drabek, *Methods of Nonlinear Analysis: Applications to Differential Equations*, Birkhauser verlag AG, 2007