Positivity Principles and decay of Solutions in Semilinear Elliptic Problems

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Timetable: 8 hrs, First lecture on September 14, 2020*. A tentative timetable will follow.

Course requirements: Students should have a basic knowledge in partial differential equations.

Examination and grading:

SSD: MAT/05

Aim: The purpose of the course is to introduce two core but not widely known ideas of the linear elliptic theory, namely Allegretto–Piepenbrink positivity principle and Phragmén-Lindelöf comparison principle, and to show how these two fundamental principles provide a powerful tool in the analysis of the structure of positive solutions for large classes of semilinear elliptic equations. The course will consist of the core part, delivered in 5 lectures during the Mini-courses in Mathematical Analysis 2020, and additional 3 lectures containing advanced material.

Course contents:

Mini-course material – 5 lectures
Lecture 1: Allegretto–Piepenbrink positivity principle for linear Schrödinger operators and some corollaries: optimal and improved Hardy inequalities, Barta type inequality, torsion function estimate.
Lecture 2: Phragmén-Lindelöf comparison principles for linear Schrödinger operators, large and small positive solutions, admissible decay for sub–and super–solutions; concept of a weak and strong perturbation potentials.
Lecture 3: Nonlinear Liouville theorems for semilinear elliptic equations in unbounded domains, Serrin’s critical exponent(s), fast and slow decay solutions.

Advanced material – 3 lectures
Lecture 2: Riesz potentials and their basic properties. Decay estimates and localization principle for the Riesz potentials.

*Please, note that the first part of the course will be included in the Workshop “Minicorsi di Analisi Matematica”

References:


