

# LECTURES in FU BERLIN

Summer Semester 2009

**Title:**

Nonlocal boundary-value problems and applications

**Place:**

Free University of Berlin  
Arnimallee 7,  
Seminar room 140

**Time:**

Wednesday 10:30-12:00

**Description:**

*For students and senior mathematicians with interests in partial differential equations and functional differential equations.*

During the last decades, nonlocal interactions have been arising in an increasing number of applications, which motivated a more and more intensive study of nonlocal effects. The present course develops a unified approach to different types of nonlocal problems, where the crucial role is played by the geometrical structure of nonlocal terms.

The course is devoted to the contemporary theory of linear elliptic equations with nonlocal boundary conditions. Being a natural generalization of elliptic boundary-value problems (e.g., the Dirichlet or the Neumann problems), nonlocal problems possess many new interesting properties related to their solvability and regularity of solutions. The knowledge of such properties is also necessary for the further study of *nonlinear* elliptic and parabolic problems with nonlocal effects.

For the sake of simplicity, the whole theory will be stated for the Laplace operator with a nonlocally perturbed Dirichlet boundary condition. However, the technique developed is also applicable to much more general problems. The main questions addressed in the course are as follows:

- Solvability of nonlocal problems,
- Spectral properties,
- Regularity of solutions,
- Applications to diffusion processes arising in biophysics.

It is assumed that the students are acquainted with the theory of linear operators in Hilbert spaces and with the theory of Sobolev spaces. Basic knowledge of elliptic PDEs is also desirable. However, most of the prerequisite facts from those fields will be reminded.

The course is mainly based on the similar course of lectures given, during a number of years, by Alexander Skubachevskii and Pavel Gurevich in the Moscow Aviation Institute and in the Peoples' Friendship University of Russia.