"Basic tools for the analysis pf PDEs"

Many models in physics, biology or engineering are based on Partial Differential
Equations. Mathematical analysis is crucial to understand the properties of the solutions and thus to

design more acurate models and efficient simulation methods.

In this
series of lectures we shall present a number of tools of Functional Analysis that are of frequent
use in all these aspects of modern Applied mathematics.

We address the questions of the existence, uniqueness, and qualitative properties of the solutions, both in terms of regularity

and in terms of asymptotic behavior.

It is quite exceptional to find an explicit formula for the solution of PDEs, hence approximation techniques are important, which

leads to discuss compactness and continuity issues.

Moreover, for many evolution problems of interest, the solution does not preserve the regularity of the solutions, and we should work in a framework of weak solutions.

The lectures will consider the following questions:

- Weak derivatives, weak solutions

- Functional spaces, in particular Sobolev spaces

- Linear problems, variational methods and spectral analysis.

- Classical PDEs: heat, wave, transport, Schrodinger...

- Introduction to non linear problems