

## INTRODUCTION TO SOBOLEV SPACES AND GALERKIN METHOD FOR PARABOLIC EQUATIONS

**Aim.** The aim of this short course is to introduce the students to some modern techniques in the analysis of PDE. The course will review some advanced tools, such as Sobolev spaces and possibly compact embeddings, and then move to the proof of the global existence theorem of weak solutions to linear parabolic equations and, if times permits, to incompressible Navier-Stokes equations. The proofs will be based on a classical Galerkin method, which could be of a broader interest, and utilise the tools previously introduced.

**Duration.** 6 hours.

**Arguments.** The arguments developed during the course will be a suitable selection of the following ones. The choice may depend on the interests of the students.

**Models.** Linear parabolic equations. Incompressible Navier-Stokes.

**Methods.** Sobolev space, Fourier analysis, Galerkin methods.

**Program.**

Lecture 1: Fourier series and the  $L^2$  space of periodic functions.

Lecture 2: The Sobolev space  $H^1$ , characterisation by Fourier series.

Lecture 3: Galerkin method for linear parabolic equations and, if time permits, for incompressible Navier-Stokes.

**Bibliography.**

To be done.

**Extended Abstract.**

To be done.