Topics in Nonlinear Partial Differential Equations

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Timetable: 16 (8+8) hrs. Lectures of the first part (Proff. Soravia and Rossi) on April/May and of the second part (Prof. Evans) on May, Torre Archimede, (see the calendar).

SSD: MAT/05 Mathematical Analysis

Course contents:

The course will begin with an introduction to the basic theory of first order fully nonlinear Partial Differential Equations, in particular of Hamilton-Jacobi type. The case of convex, space-independent Hamiltonians will be dealt with by means of the Hopf-Lax formula. More general equations will be treated by introducing the notion of viscosity solution. Its basic properties will be derived, together with the comparison principle. An introduction to optimal control theory will lead to existence and uniqueness results for the Hamilton-Jacobi-Bellman equation. We will also overview the extension to non-convex equations by means of differential games. The main part of the course will then focus on more advanced and recent topics about fully nonlinear partial differential equations. It will start by illustrating some aspects of optimization theory. Some estimates for nonlinear equations will be derived by introducing the adjoint of the linearized operator. These will be applied to the study of non-convex Hamilton-Jacobi equations, as well as the infinity Laplace operator.