DOTTORATO DI RICERCA IN INGEGNERIA CIVILE E AMBIENTALE, DELLA COOPERAZIONE INTERNAZIONALE E DI MATEMATICA **- DICACIM**

Shock Waves in Fluid Dynamics (20 hours)

(Prof. Paolo Secchi)

Programme:
1-D linear models of convection-diffusion.
Single conservation laws in one space dimension. Traffic flow. Inviscid and viscous Burgers equation, Cole-Hopf transformation. Formation of singularity and blow up in finite time. Shock waves. Rankine-Hugoniot jump condition. Entropic solutions. Riemann problem. Self-similar solutions, rarefaction waves.

Hyperbolic and strictly hyperbolic systems. Equations of non-isentropic gas dynamics. Lagrangian mass coordinates, p-system. Shallow water equations.
Lax entropy inequalities for shock waves. Riemann problem for the p-system: back and front shock and rarefaction curves. The shock tube problem. Resolution of the Riemann problem for general initial data. Interaction of two front shock waves.

References:
[1] A. Bressan: Hyperbolic systems of conservation laws. The one-dimensional Cauchy problem. Oxford Lecture Series in Mathematics and its Applications, 20. *Oxford University Press, Oxford*, 2000.
[2] G. Evans: Partial differential equations. Second edition. Graduate Studies in Mathematics, 19. *American Mathematical Society, Providence, RI*, 2010.
[3] J. Smoller: Shock waves and reaction-diffusion equations. Second edition. Grundlehren der mathematischen Wissenschaften [Fundamental Principles of Mathematical Sciences], 258. *Springer-Verlag, New York*, 1994.