International Doctorate in Civil and Environmental Engineering

DOCTORAL COURSE

Fundamental of Fluid Mechanics

Teachers: Prof. **Luca Solari -** Prof. **Federico Domenichini**

DICEA, Università degli Studi di Firenze

luca.solari@unifi.it - federico.domenichini@unifi.it

Calendar	
03/02/2020, 09,00-13,00 – Aula 110, Scuola di Ingegneria, Via di S. Marta 3, Firenze	Solari
10/02/2020, 09,00-13,00 – Aula 104, Scuola di Ingegneria, Via di S. Marta 3, Firenze	Solari
12/02/2020, 12,00-14,00 – Aula 104, Scuola di Ingegneria, Via di S. Marta 3, Firenze	Domenichini
14/02/2020, 12,00-14,00 – Aula 106, Scuola di Ingegneria, Via di S. Marta 3, Firenze	Domenichini
19/02/2020, 12,00-14,00 – Aula 107, Scuola di Ingegneria, Via di S. Marta 3, Firenze	Domenichini
21/02/2020, 12,00-14,00 – Aula 104, Scuola di Ingegneria, Via di S. Marta 3, Firenze	Domenichini
Total	16 hours – 8 credits

Program
The aim of the lectures is to give an introduction to fluid mechanics. Basic definitions about fluid dynamics are recalled. Afterwards, the mathematical definition of kinematics and dynamics of the fluid is developed in a rigorous manner.

Fluid properties. Lagrangian and Eulerian approaches. The time derivatives. Flow descriptions. Some basic integral-differential identities. Integral and differential laws of conservation of mass, momentum, angular momentum, kinetic energy. Reynolds transport theorem. Kinematic boundary conditions. Cauchy's hypothesis and law. Dynamic boundary conditions. The influence of the surface tension. Euler approximation (inviscid flows). Stokes fluids and Newtonian ones. The Navier Stokes equations. Analytical and approximate solutions. Vorticity definition and dynamics, incompressible and barotropic flows. Circulation, definition and equations. Helmholtz theorems. Irrotational flows. Biot-Savart law. Singularity in the vorticity distribution. Image vorticity. Effect of viscosity (Lamb-Oseen, Burger's solution). The boundary layer. Solutions of the Navier Stokes equations (Rayleigh, Stokes, Couette). Prandtl's approximation. The separation of the boundary-layer, experimental evidences. Examples. |