Fundamental of Fluid Mechanics

Professors

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Institution

Dpt. Civil and Environmental Engineering, University of Florence

General Information

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 fluids 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. Low Reynolds number flows (creeping flows). Vorticity definition and dynamics, incompressible and barotropic flows. Circulation, definition and equations. Helmholtz theorems. Irrotational flows. Wave motion, linear wave theory (Airy solution). Wave transformation from deep- to shallow- waters (shoaling, refraction, breaking). Biot-Savart law. Singularity in the vorticity distribution. Image vorticity. Effect of viscosity (Lamb-Oseen, Burger's solution). The boundary layer concept. Solutions of the Navier Stokes equations (Rayleigh, Stokes, Couette). Prandtl's approximation. The separation of the boundary-layer, experimental evidences. Examples.

Materials

Material (slides, books) will be available in the institutional repository of the course, upload is in progress.

Didattica INDICEE - Google Drive

https://drive.google.com/drive/folders/1H_qSx-5YbHkIXbSIP_rfGvXQ97yjEli_

Schedule

Dates	Teacher	Classroom/link	Topic
07 March 2023 – 17:00-19:00	Solari		Kinematics
09 March 2023 – 17:00-19:00	Solari		Dynamics

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Dates	Teacher	Classroom/link	Topic
15 March 2023 – 17:00-19:00	Solari		Navier-Stokes equations
16 March 2023 – 17:00-19:00	Solari		Dimensionless equations
21 March 2023 – 17:00-19:00	Solari		Stokes I and II, Couette flow
23 March 2023 – 15:00-17:00	Domenichini		Vorticity dynamics
30 March 2023 – 15:00-17:00	Domenichini		Irrotational flows
04 April 2023 – 15:00-17:00	Domenichini		Irrotational flows
06 April 2023 – 15:00-17:00	Domenichini		Low Reynolds number flows
11 April 2023 – 15:00-17:00	Domenichini		Boundary layer
17 April 2023 – 15:00-17:00	Cappietti		Wave motion, linear wave theory (Airy solution)
18 April 2023 – 15:00-17:00	Cappietti		Wave transformation from deep- to shallow-waters (shoaling, refraction, breaking)
			Total 24 Hours - 12 Credits

Other information

Location: School of Engineering, Via di S. Marta 3, Firenze.

The lectures can be also followed on-line, links are given in the table.

The course will be approved after an oral examination of the students based on the description and discussion of a paper in a peer-reviewed journal agreed in advanced with the teachers.

Examination Committee: Professors Cappietti, Domenichini, Francalanci, Solari.

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