Fundamental of Fluid Mechanics

Professors	Email	Institution
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General Information

The course is held both **in presence** (Room 138 '*Aula riunioni*' at the Dept. of Civil and Environmental Engineering, School of Engineering, via di Santa Marta 3, Firenze, first floor, east wing) and **online** (google meet, links are given in the table). Any changes to the schedule (date, time, classroom) will be communicated with adequate notice.

Contents: 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 evolving equation, incompressible and barotropic flows. Circulation, definition and equations. Helmholtz theorems. 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. Irrotational flows. Wave motion, linear wave theory (Airy solution). Wave transformation from deep- to shallow- waters (shoaling, refraction, breaking).

Materials

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

Didattica INDICEE - Google Drive

Schedule

Dates	Teacher	Classroom/link	Topic
05 May 2026 – 17:00-19:00	Solari	https://meet.google.com/ktk-zwwz-hzb	Kinematics
07 May 2026 – 17:00-19:00	Solari	https://meet.google.com/ktk-zwwz-hzb	Dynamics
12 May 2026 – 17:00-19:00	Solari	https://meet.google.com/ktk-zwwz-hzb	Navier-Stokes equations
14 May 2026 – 17:00-19:00	Solari	https://meet.google.com/ktk-zwwz-hzb	Dimensionless equations
19 May 2026 – 17:00-19:00	Solari	https://meet.google.com/ktk-zwwz-hzb	Stokes I and II, Couette flow
21 May 2026 – 17:00-19:00	Domenichini	https://meet.google.com/xom-qzby-oby	Vorticity dynamics
26 May 2026 – 17:00-19:00	Domenichini	https://meet.google.com/xom-qzby-oby	Irrotational flows
28 May 2026 – 17:00-19:00	Domenichini	https://meet.google.com/xom-qzby-oby	Irrotational flows
04 June 2026 – 17:00-19:00	Domenichini	https://meet.google.com/xom-qzby-oby	Low Reynolds number flows
09 June 2026 – 17:00-19:00	Domenichini	https://meet.google.com/xom-qzby-oby	Boundary-layer
22 June 2026 – 15:00-17:00	Cappietti	https://meet.google.com/icz-ztso-mtw	Wave motion, linear wave theory (Airy solution)
23 June 2026 – 15:00-17:00	Cappietti	https://meet.google.com/icz-ztso-mtw	Wave transformation from deep- to shallow-waters (shoaling, refraction, breaking)
			Total 24 Hours - 4 Credits

Other information

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, Solari

For any information www.indicee.unifi.it - dott-dicea@unifi.it