Laurea Magistrale
Atmospheric Science and Technology (LMAST)

SUBJECT TITLE	Fundamentals of fluid mechanics
TEACHER NAME(S)	Monica Moroni
Teacher e-mail (s)	monica.moroni@uniroma1.it
Teacher phone	+390644585638
Teacher meeting	Monday, h. 12-13
Teacher office address	Via Eudossiana 18, Rome (S. Peter in chain site)
DISCIPLINE (SSD)	ICAR/01
Semester (1-4)	1 (first) & Rome at Via Eudossiana
Credits (CFU/ECTS)	6
Lecture hours (h)	60 (45 lectures + 15 exercise/laboratory)
Prerequisite and learning activity	Physics, Algebra
Teaching language and method	English & Lectures, exercises and homeworks
Assessment method	Written and Oral examination
SUBJECT WEBSITE	https://www.dicea.uniroma1.it/user/137/

OBJECTIVES

Main goals are:
- to provide the student a foundation in the fundamentals of fluid mechanics
- to grasp the basic ideas of turbulence
- to understand the dynamics of fluid flows and the governing non-dimensional parameters
- to apply concepts of mass, momentum and energy conservation to flows
- to introduce to experimental methods
- to study analytical solutions to variety of simplified problems

OUTCOMES (Dublin descriptors: knowledge, understanding, explain, skill, ability)

After the successful completion of this module, the student should be able to:
- know the definitions of fundamental concepts of fluid mechanics including: continuum, velocity field; viscosity, surface tension and pressure (absolute and gage); flow visualization using timelines, pathlines, streaklines, and streamlines; flow regimes: laminar, turbulent and transitional flows; compressibility and incompressibility; viscous and inviscid;
- use of conservation laws in integral form and apply them to determine forces and moments on surfaces;
- use of conservation laws in differential forms and apply them to determine velocities, pressures and acceleration in a moving fluid;
- understand the kinematics of fluid particles, including the concepts of substantive derivatives, local and convective accelerations, vorticity and circulation;
- use Euler's and Bernoulli's equations and the conservation of mass to determine velocities, pressures, and accelerations for incompressible and inviscid fluids;
- apply principles of dimensional analysis and similitude to simple problems and use dimensionless parameters.

PROGRAM CONTENT

BASIC CONSIDERATIONS. Dimensions, Units, and Physical Quantities. Continuum view of Gases and Liquids. Fluid properties. Thermodynamic Properties and Relationships.
FLUID STATICS.
FLUIDS IN MOTION. Lagrangian and Eulerian Descriptions of Motion. Pathlines, Streaklines, and Streamlines. One-, Two-, and Three-Dimensional Flows. Viscous and Inviscid Flows. Laminar and Turbulent Flows. Incompressible and Compressible Flows. The Bernoulli Equation.
THE INTEGRAL AND DIFFERENTIAL FORMS OF THE FUNDAMENTAL LAWS. Conservation of Mass. Energy Equation. Momentum Equation. Differential Continuity Equation. Differential Momentum Equation. Differential Energy Equation.
DIMENSIONAL ANALYSIS AND SIMILITUDE.
EXTERNAL FLOW OF INCOMPRESSIBLE AND VISCOUS FLUIDS. Viscous flows, exact solutions, pipe flow.
INTRODUCTION TO TURBULENCE
MEASUREMENTS IN FLUID MECHANICS. Measurements of Local Flow Parameters. Flow Rate Measurement. Flow Visualization. Uncertainty Analysis.

REFERENCES AND MATERIAL

- Texts and slides provided by the teacher and available on the course web site.

Potter M.C. and Wiggert D.C., Mechanics of fluids. Brooks/Cole 2002.