Laurea Magistrale
Atmospheric Science and Technology (LMAST)

SUBJECT TITLE	Advanced Fluid Mechanics
TEACHER NAME(S)	Stefania Espa(3CFU), Giovanni Leuzzi (3CFU)
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Teacher meeting	Friday, h. 15-16
Teacher office address	Via Eudossiana 18, Rome (S. Peter in chain site)
DISCIPLINE (SSD)	ICAR 01
Semester (1-4)	2
Credits (CFU/ECTS)	6
Lecture hours (h)	60 (40 lectures + 20 laboratory exercitations)
Prerequisite and learning activity	Fundamentals of Fluid Mechanics
Teaching language and method	English & Lectures, exercises and homeworks
Assessment method	Oral examination
SUBJECT WEBSITE	https://www.dicea.uniroma1.it/user/98/; https://www.dicea.uniroma1.it/user/118/

OBJECTIVES

Main goals are:
-To introduce the students to advanced topics in fluid mechanics and its modeling
-To furnish tools for the study of atmospheric dispersion
-To train the students to laboratory simulation of geophysical flows

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

After the successful completion of this course, students should:
-deal with complex problems related to geophysical flows
-deal with atmospheric dispersion problems
-work efficiently within a group, with particular reference to perform laboratory experiments and write a report on experimental activities.

PROGRAM CONTENT

INTRODUCTION : Review on conservation laws and scaling analysis. VORTICITY DYNAMICS: Circulation equation. Kelvin's and Helmholtz's theorems. Vorticity equation in a non-rotating and a rotating frame of reference. TURBULENCE: Equations of motion. Turbulent energy cascade and spectrum. The effect of rotation and stratification. DISPERSION OF PASSIVE TRACERS: The Balance equation of passive scalars. Eulerian dispersion models. K-models. Gaussian models. Puff models. Lagrangian dispersion models. Statistical equation of concentrations. Taylor analysis. Random walks. The Wiener process. The Langevin equation. Application of numerical models to practical dispersion problems. LABORATORY FLUID MECHANICS: Velocity measurements. Image Analysis Techniques: Particle Image Velocimetry and Particle Tracking Velocimetry (PIV and PTV). Applications.

REFERENCES AND MATERIAL

Kundu, Cohen, Dowling Fluid Mechanics, Academic Press 2012
Text and materials provided by the teachers.