Academic subject: Advanced Mechanics				
Degree Class: L-35 – Scienze Matematiche		**Degree Course:** Mathematics	**Academic Year:** 2018/2019	
		Kind of class: Optional	**Year:** 3	**Period:** 2
			ECTS: 7 divided into **ECTS lessons:** 6,5 **ECTS exer/lab/tutor:** 0,5	
Time management, hours, in–class study hours, out–of–class study hours lesson: 52 exe/lab/tutor: 8 in–class study: 60 out–of–class study: 115				
Language: Italian	**Compulsory Attendance:** no			
Subject Teacher: Arcangelo Labianca	**Tel:** +39 080 5442656 **e–mail:** arcangelo.labianca@uniba.it	**Office:** Department of Mathematics Room 7, Floor II	**Office days and hours:** Tuesday, 3-6 p.m.	
Prerequisites: Linear and affine algebra. General topology. Calculus of real functions of several variables. Mechanics of point, of systems of particles, of continuous rigid systems. Fundamentals of thermodynamics and electrodynamics.				
Educational objectives: Knowledge of the most important principles and results in kinematics of deformable continuous system, in mechanics of viscous fluids, in thermodynamics and magnetofluiddynamics of continuous systems and application of them to fluid dynamics problems.				
Expected learning outcomes (according to Dublin Descriptors)	**Knowledge and understanding:** Acquiring the language, the mathematical formalism and tools and the knowledge of the main results that make it possible for the student the consultation and understanding of fluid dynamics textbooks and articles. **Applying knowledge and understanding:** Acquiring the language, the mathematical formalism and tools and the knowledge of the main results that let the student to describe, analyze and solve fluid dynamics problems. **Making judgements:** Reaching the capability of selecting techniques and theoretical tools needed to face up to fluid dynamics problems. **Communication:** Mastering the introduction and presentation of objects and results already studied with mathematical accuracy and physical sense. **Lifelong learning skills:** Reaching the skill in self-studying and self-learning new knowledge about fluid dynamics from books and articles.			

Course program

Deformable continuous systems. Regular motions. Lagrangian and eulerian point of view. Deformation of a continuous system. Green and Cauchy deformation matrices. Linear dilation coefficient. Angular deformation. Cubic dilation coefficient. Velocity field for a deformable continuous system.
Equations of the dynamics of continuous system. Mass continuity equation. Stresses in a continuous system. Balance equation of linear and angular momentum. Cauchy stress theorem and stress tensor. Local form of the balance equations. Vortex vector. Beltrami equation.
Equazioni costitutive e fluidi newtoniani. Constitutive equations. Perfect fluids. Bernoulli theorem. Linear viscous fluids. Navier-Stokes equation for an incompressible viscous fluid.
Classical thermodynamics of continuous systems. First and second principle of thermodynamics. Dissipation function. Navier-Stokes equation for thermoconducting fluids.
Magnetofluiddynamics. Maxwell equations (for continuous systems). Nonrelativistic magnetofluiddynamics equations. Lorentz force. Decay of the magnetic field in a fluid at rest. Alfven theorem.
About the fluid dynamics equations. Motions of an incompressible viscous fluid. Uniqueness of the solutions.
Solutions of the fluiddynamics equations. Couette and Poiseuille solutions in fluiddynamics. Couette and Hartmann solutions in magnetofluiddynamics.

Teaching methods: Lecture and exercise sessions.

Auxiliary teaching: Teacher-provided course notes.

Assessment methods: Oral exam.

Bibliography:
J. Serrin – Mathematical principles of Classical Fluid Mechanics, Handbuch der Physik, Band VIII/1
S. Rionero – Appunti di Magnetofluidodinamica