Università degli Studi della Basilicata
Scuola di Ingegneria

COURSE: Fluid Mechanics	
TEACHER: Dr. Marilena Pannone	
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Language Italian	

ECTS: 9	n. of hours: 90	Academic year: 2015/2016	Campus: Potenza	Semester: 1/2

TOPICS

Fluid physical properties; Dimensional analysis and similitude; Laboratory fluid-dynamical models. Analysis of fluid stress; Kinematics of fluids and deformation analysis; Flow integral analysis. Fluid streams. Action and reaction turbines. Pumps; Flow differential analysis. Cauchy's equation. Euler's equation. Navier-Stokes' equation; Dynamics of the non-viscous fluids. Bernoulli's theorem and phoronomy; Basics of rotational and irrotational flows; Potential flows; Turbulence. Reynolds' equation. Outline of boundary layer theory; Confined viscous fluid streams and their steady flow. Resolution of simple conduits systems. Unsteady flow of confined fluid streams. Oscillations of mass and elastic oscillations. Conformal mapping. Joukowski's transformation and airfoils.

TEACHING METHODS (please tick one or more options)
X Theoretical lessons
X Tutorials in classroom
□ Tutorials in laboratory
□ Project works
□ Technical visits
Other activities (please specify) ____

TEXTBOOKS
A.Ghetti: Idraulica, Ed. Libreria Cortina – Padova
E.Marchi-A.Rubatta: Meccanica dei Fluidi, UTET - Torino
M. Mossa-A.F. Petrillo: Idraulica, CEDAM - Milano
Lecture notes provided by the teacher.

ON-LINE EDUCATIONAL MATERIAL
web address:

LEARNING OUTCOMES
Acquisition of the basic Fluid Mechanics concepts and analysis tools; acquisition of the capability to use them for the solution of technical-practical problems where their application is required, resorting to the theory and to simple numerical codes.

REQUIREMENTS
Passing the exams of Mathematical Analysis I and Physics I before beginning with the Fluid Mechanics classes is highly recommended.

EVALUATION METHODS (please tick one or more options)
x Intermediate verifications
x Written examination
□ Discussion of a project work
□ Practical test
x Oral examination
Other methods (please specify) ____

DETAILED CONTENT
Dimensions and units. Density and specific gravity. Fluids compressibility. Viscosity. Non-viscous fluids. Non-

Newtonian fluids. Surface tension and capillarity.

Physical quantities and dimensional independency. Homogeneity criterion. Buckingham's theorem; applications: resistance to uniform flow in horizontal, circular cross-section conduits. The dimensional analysis in Fluid Mechanics. Mechanical similitude between fluid-dynamical phenomena. Outline of the fluid-dynamical models.

The pressure. Pressures' tensor. Principal pressures. Isotropic pressure. Pressures' tensor invariants.

Fluids in static conditions. Undefined equilibrium equations: hydro-statics, fluids in rigid, accelerated or non accelerated flow conditions. Pascal's law. Pressure measurements. Hydro-static pressure on flat or open curved surfaces. Hydro-static pressure on curved closed surfaces. Fully submerged bodies. Floating bodies.

Steady/unsteady, uniform/non uniform flows. Velocity. Trajectories and streamlines. The concept of total derivative. Acceleration. Kinematics of fluids. The deformation.

Fluid system and control volume. Mass balance referred to a fluid system and a control volume. Transport theorem. Momentum conservation equations. Fluid streams. Applications of the momentum conservation equations for steady flows and incompressible fluids: dynamical pressure of a free jet on a plain wall; Pelton action turbine; jet propulsion; reaction turbines and pumps.

Differential continuity equation. Differential momentum conservation equation: Cauchy's equation. Constitutive relation for non-viscous fluids and for linear viscosity fluids. Flow equation for non-viscous fluids: Euler's equation. Flow equation for linear viscosity fluids: Navier-Stokes' equation. Flow equations boundary conditions.

Complete equations system for the study of a non-viscous fluid flow. Applications: Bernoulli's theorem. Extension of Bernoulli's theorem to the whole stream. Basics of phoronomy; stagnation pressure; Pitot's tube; Venturi's tube; elementary propeller theory; abrupt cross-section widening in confined streams.

Vorticity. Irrotational flows: velocity potential. Bernoulli's theorem for irrotational flows.

Stream function for a two-dimensional irrotational flow. Basic two-dimensional irrotational flows. Combinations of basic two-dimensional irrotational flows: dipoles, uniform flow around a cylinder with and without circulation and related drag and lift.

Transition from laminar to turbulent flow regime. Laminar regime: uniform flow in conduit. Turbulent regime: from Navier-Stokes' to Reynolds' flow equations. Turbulent steady and uniform flow. The logarithmic velocity wall distribution. Turbulent flow for smooth and rough wall. Flow resistance equations in uniform confined streams flow: Colebrook's formula. Moody's diagram.

Boundary layer concept. Laminar two-dimensional boundary layer. Wall shear stress for laminar and turbulent boundary layer. Boundary layer separation and flow resistance due to the unbalanced pressures.

Steady flows of incompressible fluids: resistance formulas and evaluation of energy losses. Conduit connecting two reservoirs. Problems characterizing the long conduits. Hydraulic nodes and networks. Power absorbed or supplied in a conduits system by (action-reaction) turbines and pumps.

Confined unsteady flow: oscillations of mass and elastic oscillations within an hydro-electric power plant.

Conformal mapping. Joukowski's transformation and airfoils.

EXAMINATION SESSIONS (FORECAST)
06/07/16, 27/07/16, 21/09/16, 16/11/16

SEMINARS BY EXTERNAL EXPERTS YES □ NO x

FURTHER INFORMATION