UNIVERSITÀ DI PAVIA

Anno Accademico 2020/2021

CONTINUUM MECHANICS	
Anno immatricolazione	2020/2021
Anno offerta	2020/2021
Normativa	DM270
SSD	ICAR/01 (IDRAULICA)
Dipartimento	DIPARTIMENTO DI INGEGNERIA CIVILE E ARCHITETTURA
Corso di studio	CIVIL ENGINEERING FOR MITIGATION OF RISK FROM NATURAL HAZARDS
Curriculum	Hydrogeological risk assessment and mitigation
Anno di corso	1°
Periodo didattico	Primo Semestre (21/09/2020 - 14/10/2020)
Crediti	6
Ore	51 ore di attività frontale
Lingua insegnamento	English
Tipo esame	ORALE
Docente	MANENTI SAURO (titolare) - 6 CFU
Prerequisiti	Basics of vector, matrix and tensor algebra. Mathematical foundations. Integral theorems (Stokes and Gauss).
Obiettivi formativi	The course will provide the fundamental theoretical concepts and mathematical tools for the analysis and modelling of relevant problems in the hydraulic engineering field. The students will be able to carry out computer analysis of basic engineering problems related to fluid mechanics.
Programma e contenuti	Review of mathematical foundations: vector and tensor algebra, coordinate systems, Stokes theorem and Gauss theorem. The continuum concept. Analysis of stress: Cauchy stress principle, stress tensor, principal stress, Mohr circles (introductory notes), deviator and spherical stress

	tensors. Deformation and strain: Lagrangian and Eulerian description, small deformation theory, strain tensor, principal strains, spherical and deviator strain tensors, plane strain, compatibility equations, velocity gradient tensor, rate of deformation tensor, vorticity tensor. Fundamental laws of Continuum Mechanics: mass conservation - continuity equation, Reynolds transport theorem, linear momentum conservation - Cauchy equation of motion, angular momentum conservation, energy conservation. Constitutive equations: Newtonian fluids. Governing equations of Fluid Mechanics: Navier-Stokes equation. Special cases: perfect fluid; Euler and Bernoulli equations; Laplace equation. Kelvin theorem. Viscosity of Newtonian fluids: basic concepts; flow curve. Common non-Newtonian rheological models: Bingham, pseudoplastic; dilatant. Experimental measurement of fluid viscosity, principal types of rheometers. Applications to engineering problems: CFD modeling of annular viscous fluid damper as a passive energy dissipation system. Numerical solution of the fundamental equations of fluid mechanics and engineering applications: basic concepts and assumptions of Smoothed Particle Hydrodynamics (SPH) method. SPH modeling of landslide generated wave in artificial reservoir.
Metodi didattici	Lectures on: basics of Continuum Mechanics, development of balance equations, constitutive equations and Navier-Stokes equations. Practical classes on: solution through computer programs of Navier-Stokes equations for practical problems in the field of Fluid Mechanics; experimental measurement of fluid viscosity.
Testi di riferimento	Aris R. "Vectors, Tensors, and the Basic Equations of Fluid Mechanics" Dover pub. Chou P.C. & Pagano N.J. "Elasticity, Tensor, Dyadic, and Engineering Approaches" Dover pub. Kundu P. K., Cohen I. M., Dowling D. R. "Fluid Mechanics" 6th Ed. 2016 Elsevier A.P. Liu, G-R. and Liu, M.B. "Smoothed Particle Hydrodynamics: a Meshfree Particle Method". World Scientic, 2003 Prager W. "Introduction to Mechanics of Continua" Ginn and Co. 1961 Wilkinson W.L. "Non-Newtonian Fluids". 1960 Pergamon Press. Lecture notes downloadable from https://elearning2.unipv.it/ingegneria/?lang=en.
Modalità verifica apprendimento	The final examination will consist of an oral discussion, with the possibility for each student to carry out in-depth analysis about a peculiar topic within the course contents
Altre informazioni	Lecture notes can be downloaded from the course page on the platform KIRO (https://elearning2.unipv.it/ingegneria/)
Obiettivi Agenda 2030 per lo sviluppo sostenibile	$lbl_legenda_sviluppo_sostenibile