UNIVERSITÀ DI PAVIA

Anno Accademico 2021/2022

MECHANICS OF SOLIDS

Enrollment year	2020/2021
Academic year	2021/2022
Regulations	DM270
Academic discipline	ICAR/08 (CONSTRUCTION SCIENCE)
Department	DEPARTMENT OF CIVIL ENGINEERING AND ARCHITECTURE
Course	CIVIL AND ENVIRONMENTAL ENGINEERING
Curriculum	PERCORSO COMUNE
Year of study	2°
Period	1st semester (27/09/2021 - 21/01/2022)
ECTS	6
Lesson hours	52 lesson hours
Language	Italian
Activity type	WRITTEN AND ORAL TEST
Teacher	CARLI FABIO (titolare) - 6 ECTS
Prerequisites	Understanding of the essential contents of the courses of Calculus, Algebra, Physics and Mathematical Physics is considered fundamental for the productive attendance at the course. In particular, the following are considered essential and therefore acquired: elementary operations on vectors (analytical and graphic) and matrices (linear systems, diagonalization, inversion, ...), the concept of force (elastic, viscous, friction, inertia,. ..), foundations of statics and kinematics of the rigid body and elements of calculus (integrals, exact differential, ordinary and partial differential equations, ...).
Learning outcomes	The course aims to provide necessary tools for the knowledge and comprehension of essential mechanics of the deformable body in linear elasticity, whose assimilation is a required basis for other courses both theoretical and practical not strictly limited to civil engineering. The theoretical developments will be frequently explained with examples and applications aimed at providing the cognitive means for a first autonomy

	in structural evaluation. At the end of the course students will be able to estimate the state of stress and deformation in a generic point of a particular class of generically loaded solids, indicating the distance from the intrinsic resistance limit of the used material.
Course contents	STRESS STATE - General aspects of the structural problem. Forces and stress vectors. Cauchy's stress tensor. Principal stresses and principal directions, stress invariants, hydrostatic and deviatoric component. 2D and 3D stress states. Mohr stress representation. Equilibrium conditions. STRAIN STATE - Compatibility of the deformable body and kinematics of motion. The Green-Lagrange finite strain tensor. Geometric approximation and introduction of the “small” strain tensor. Principal components, directions and invariants. Physical interpretation and meaning of the strain components. Volume variation and shape variation. Internal compatibility conditions. BUILDING MATERIALS - Ideal behavior. Outline of common experimental testing of materials and experimental measurements of deformation. CONSTITUTIVE LAW - Stress-strain relations and experimental evidence. Elasticity, anelasticity, collapse and time dependence. The elastic constitutive law: energy aspects, existence and uniqueness of the elastic response. Elastic-linear-isotropic law: engineering elastic constants, direct and inverse relations. Elastic limit and resistance criteria. Collapse and yield criteria. Formulation of the elastic problem and uniqueness of the solution. From the measurement of deformations to the evaluation of the state of local effort. WORK AND ENERGY - Virtual work theorem. Energy forms and energy theorems: an outline. A SPECIALIZED SOLID: THE BEAM - Statement of the Saint-Venant’s problem. Axial action. Simple bending, combined bending and bending with axial force. Torque: exact and approximate solutions. Bending with constant shear: approximate treatment. ELEMENTS OF STABILITY OF ELASTIC EQUILIBRIUM - Formulation of the problem for systems with concentrated elasticity and the Euler beam. Euler curves for ideal material and real materials.
Teaching methods	Lectures (h/y, frontal): 36 Applications (h/y, frontal): 18 Practice (h/y, frontal): 0
Reccomended or required readings	- Corradi Dell’Acqua L., Meccanica delle Strutture Vol. I - Il comportamento dei mezzi continui, McGraw-Hill, Milano. - Beer F.P., Russell Johnston Jr. E., DeWolf J.T., Mazurek D.F., Meccanica dei solidi - 5/ed., McGraw-Hill, Milano.
Assessment methods	Single exam calls for (A module + B module). The exam includes a written test (3 hours) and an oral examination immediately following the written test. The written test cannot be transferred to another call. The written test is evaluated and discussed in the initial part of the oral examination which continues only in case of positive script. The final grade will be obtained by mediating the results of the two parts.

Further information

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Sustainable development

goals - Agenda 2030	$lbl_legenda_sviluppo_sostenibile