UNIVERSITÀ DI PAVIA

Anno Accademico 2021/2022

SOLID AND STRUCTURAL MECHANICS

Enrollment year	2019/2020
Academic year	2021/2022
Regulations	DM270
Academic discipline	ICAR/08 (CONSTRUCTION SCIENCE)
Department	DEPARTMENT OF CIVIL ENGINEERING AND ARCHITECTURE
Course	
Curriculum	PERCORSO COMUNE
Year of study	3°
Period	1st semester (27/09/2021 - 21/01/2022)
ECTS	9
Lesson hours	86 lesson hours
Language	Italian
Activity type	ORAL TEST
Teacher	VENINI PAOLO (titolare) - 9 ECTS
Prerequisites	1) Rigid body equilibrium equations, course of Meccanica Razionale (Rationale Mechanics) 2) Multivariable integral and differential calculus, course of Analisi Matematica 2 (Mathematical Analysis 2) 3) Linear algebra, course of Geometria (Geometry)
Learning outcomes	At the end of the course the student must: a) know the quantities suitable to describe the stress and deformation state of civil constructions as well as the methodologies for calculation and verification in the most recurring cases in practice, i.e. framed structures; b) understand the duality between equilibrium equations on the one hand and compatibility on the other and their synthesis through the principles of virtual works; c) know the main construction materials by translating their mechanical behavior into constitutive equations indispensable for calculating the solution.

Course contents

The structural analysis of framed structures is introduced within the framework of beam theory and calls for the computation of contraints reactions and internal actions. Cauchy theory of continuum mechanics is introduced afterwards to give substabce to a few results that were previously achieved euristically. Also this is the natural environment wherein strength of materials may be investigated so as to allow the design of simple structural components.

Mechanics of rigid systems
a) Statics and kinematics, constraints and loads.
b) Kinematic analysis: analytic versus synthetic approach, the role of the instantaneous centre of rotation.
c) Static analysis: equilibrium equations, kinematic vs static govern.ng matrix.
d) Internal actions: axial force, shear, bending and twisting moments; indefinite equilbrium equations, concentrated loads, beams with curvilinear axis

Mechanics of deformable beams and frames
a) Motivations: hyperdeterminate structures, the role of the material.
b) Elastic behavior with a view on elastoplasticity.
c) Thin beams: conservation of plane sections, elastica, Mohr's corollaries, theorem of virtual works, force method, displacement method, energetic appproach

Continuum mechanics and Saint Venant problem
a) equilibrium and compatibility conditions for deformable bodies: stress and strain tensors.
b) elasticity, isotropy and linearity; steel as an elastic material.
c) the problem of Saint Venant: pure traction, pure bending, shear, torque.
d) strength of materials: motivations and use (von Mises and Tresca)
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Additional arguments
a) Instability of equilibrium: analysis and design of columns including second order effects.
b) Computer structural analysis: the finite element method.
c) Ultimate bearing capacity of structures

Teaching methods

Lectures: 80 hours per year
Problems and exercises: 40 hours per year

Reccomended or required readings

1) Alberto Taliercio, Introduzione alla Meccanica dei Solidi, ed. Esculapio

2) Nicola Cefis, Esercizi di Meccanica dei Solidi e delle Strutture, ed. Esculapio

3) Solved exam problems handed out by the instructor

Assessment methods

The test consists of a written test followed, in case of a positive result, by an oral test (both mandatory). The written test normally lasts three hours and involves the solution of hyperstatic structures (hyperdetermined) and the consequent verification in the elastic limit state. If the written test is sufficient, the student is admitted to the compulsory oral test which covers the entire program. Each written test, without exception, is valid only for the session during which it is taken. The oral test usually takes place a few days after the written test.

Further information

The test consists of a written test followed, in case of a positive result, by an oral test (both mandatory). The written test normally lasts three hours and involves the solution of hyperstatic structures (hyperdetermined) and the consequent verification in the elastic limit state. If the written test is sufficient, the student is admitted to the compulsory oral test which covers the entire program. Each written test, without exception, is valid only for the session during which it is taken. The oral test usually takes place a few days after the written test.

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