Anno Accademico 2021/2022

STRUCTURAL MECHANICS	
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	50 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 beam in linear elasticity, whose assimilation is a required basis for other courses both theoretical and practical. The theoretical developments will be explained by means of extensive use of examples and applications aimed at providing both abstract ant practical means for a first autonomy in structural evaluation.

	At the end of the course the students must be able to solve complex isostatic beams systems and simple hyperstatic elements loaded in general way using both synthetic/graphical and analytical methods. The basics of structural design and dimensioning will complete the training.
Course contents	KINEMATICS OF THE RIGID BODY - Compatible motion and constraints. Kinematics of the beam: analytical and synthetic approaches. STATIC OF THE RIGID BODY - Systems of external forces and constrain reactions. Statics of the beam: analytical and synthetic (graphic) solution. Kinematic and static determination. Duality of the static-kinematic problem. INTERNAL ACTIONS - Definition of internal action and evaluation of the force conditions in simple beams. Indefinite equations of equilibrium for the plane (2D) straight beam and equations of the internal actions. Analytical evaluation of the internal forces. BEAM SYSTEMS - Synthetic kinematic analysis and statics of simple isostatic beams. Trusses. Complex systems and their synthesis with estimation of internal action diagrams. Kinematic and static approach to indeterminate systems. DISPLACEMENTS AND DEFORMATIONS - Indefinite compatibility equations for the 2D straight beam. BASICS OF MASS GEOMETRY. ISOTROPIC LINEAR ELASTIC LAW - Formulation of the elastic problem and constitutive equations. The theorem of virtual works and basic energy aspects. Energy theorems: an outline. SOLUTION METHODS – Beams primarily in bending. The principle of effects superposition. Equation beam equation. Shear displacements. Mohr's analogy. Calculation of displacements and solution of hyperstatic beams. Application of the virtual work theorem. Anelastic and elastic constrained displacements. Thermal loads. Force methods and displacement methods: an outline. ELEMENTS OF BEAM DESIGN - Verification of sections under generic force conditions and basic design of beams. BEAMS IN BENDING AND COMPRESSION - Evaluation of the Euler critical load for simple beams in 2D and 3D. Design basics of columns under centered and eccentric buckling.
Teaching methods	Lectures (h/y, frontal): 36 Applications (h/y, frontal): 18 Practice (h/y, frontal): 0
Reccomended or required readings	- Bucci G., Cinquini C., Elementi di Teoria della Trave e Soluzioni Strutturali, Schonenfeld & Ziegler, Milano. - 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	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.
Sustainable development goals - Agenda 2030	$lbl_legenda_sviluppo_sostenibile