Degree course	Science of Architecture
Course code	
Lecturer	**Paolo Fuschi**
Course name	**Solids and Structural Mechanics** Part 1 and Part 2
Disciplinary area	Civil Engineering and Architecture
Disciplinary field of science	ICAR/08 Solids and Structural Mechanics
University credits - ECTS	8 (4+4)
Teaching hours	80
Course year	Third
Semester	First

Synthetic description

The Course is aimed at providing to the Students an understanding of the physical-mechanical behavior of solids and structural elements refining their intuition on the analysis of existing or new structures. The main topics are: continuous solids, stress and strain analysis, strength criteria, technical theories able to provide analytical models for the calculation of statically determined and undetermined structural elements. Particular attention is given to the structural elements made of masonry viewed as no-tension-materials. The proposed learning process contemplates the introduction of theoretical concepts always with reference to real problems related to a real structural design process.

Course entry requirements

Calculus, Statics

Course programme

Introduction: general concepts, buildings, structures, structural elements, structural elements analysis, course and lesson plan. **Analysis of Continuum**: stress and strain concepts, tests on materials, stress-strain relationships, generalized Hooke's law. The Saint Venant principle, the technical theory of the beam, simple statically undetermined problems. **Simple loads on beams:** axial force, pure bending, bending in homogeneous and nonhomogeneous materials, bending of members made of several materials, simple shear, shear in bending, torsion, unsymmetric bending, buckling and Eulerian critical load. **Not simple loads on beams:** bending in presence of axial force; neutral axis, position of neutral axes and central core, no tension materials. **Masonry structures**: general consideration and remarks, the arches, the vaults, the verification and the design. **Deformation in structural elements**: introductory concepts, strain analysis under axial force, strain analysis under bending, examples (cantilever beam, simple supported beam). Kinematic method, the elastic, the multi-span beams, the continuum beams, the virtual work principle, the unit force method. **Undetermined structures**: the force method, single span beams, practical examples, the virtual work principle as a solving method, Statically undetermined plane structures. **Methods of verification**: the ultimate-limit-state method.

Expected results

Students are required to acquire skills to carry out a complete structural analysis in the field of structural engineering defining an appropriate mechanical model in terms of constituent material, geometry, boundary and loading conditions and adopting an analysis method to solve the related boundary value problem. The final goal of the course is to give all the theoretical and technical information aimed to plan structural interventions for repairing and restoring existing buildings as well as to design new structures also with reference to seismic actions.

Course structure and teaching

Lectures *(hours/year): 60*
Exercises *(hours/year): 20*

Student's independent work

Exercises, Applicative work and practical tests.

Testing and exams

The acquired knowledge will be verified through tests developed during and / or at the end of the course and through an oral exam. In particular, a written test is envisaged in which the student can acquire 4 CFUs and an oral exam in which the student can acquire 4 more CFUs. The questions that form the written test or the oral exam will cover both theoretical issues and the solution of simple structural organisms treated during the classroom exercises and, finally, the discussion of application works developed during the year .

Suggested reading materials

In Italian:

S. Di Pasquale, C. Messina, L. Paolini, B. Furiozzi- *Nuovo Corso di Costruzioni- Vol.* ***1,2,*** Le Monnier, 2009

F. P. Beer, E. R. Johnston, *Scienza delle Costruzioni, introduzione alla meccanica dei materiali*, Ed.McGraw-Hill libri Italia s.r.l., Milano, 1997.

E. Viola, *Esercitazioni di Scienza delle Costruzioni – vol.* ***1*** *e* ***2***, Pitagora, Bologna, 1993(vol 1), 1985 (vol 2).

O. Belluzzi, *Scienza delle Costruzioni – vol. I,* Ed. Zanichelli, Bologna, 1982.

E.Benvenuto, La *Scienza delle Costruzioni e il suo sviluppo storico*, Ed. Sansoni, Firenze, 1981.

Esercizi svolti -- http://www.pau.unirc.it/scheda_persona.php?id=612.

In English:

F. P. Beer, E. R. Johnston, J.T. DeWolf, D.F. Mazurek. *Mechanics of Materials*, McGraw-Hill Education, 7th Edition, 2014.

E.P. Popov. *Engineering mechanics of solids*, Prentice Hall 2nd Edition, 1998.

J.R. Barber, A.Klarbring. *Solid Mechanics and its Applications*, Springer Series, 1990-2016.

Solved Exercises -- http://www.pau.unirc.it/scheda_persona.php?id=612.