Degree Course	Second Cycle Degree Course in Architecture - Class LM-4
Course code	1001143
Lecturer	ALBA SOFI
Course name	STATICS
Disciplinary area	Structural analysis and design for Architecture
Disciplinary field of science	ICAR/08- Mechanics of Solids and Structures
University credits - ECTS	6
Teaching hours	60
Course year	II
Semester	I

Synthetic description and specific course objectives

The aim of the Course of Statics is to provide the theoretical knowledge and analytical tools for understanding the physical-mechanical behaviour of structures.
The Course concerns: the statics and kinematics of rigid bodies; the analysis of plane beam systems idealized as assemblages of constrained rigid bodies.
Presentation of theoretical material is always accompanied by practical examples in order to provide methodological-practical tools as well as to show the relationship between analytical models and real structures.
The students must acquire basic knowledge on theoretical-scientific and methodological-practical aspects of Statics. Such a knowledge will enable students to identify the load-resisting mechanism of a structure, to represent it through a suitable mathematical model and then analyze its static behaviour. The specific objective of the Course is to acquire knowledge of structural design problems (Art. 2 of the Teaching Regulations) related to the design of buildings.

Course entry requirements

Knowledge acquired during the Course of “Mathematical Institutions” (preparatory): elementary algebra, differential and integral calculus, functions. Basic knowledge of geometry, trigonometry and matrix analysis.

Course programme

Introduction to the Theory of Equilibrium
Introduction to Statics as the branch of Classical Mechanics that studies the Theory of Equilibrium; notions of force, action, structure, constraint and reaction.

Fundamentals of vector theory
Elementary operations on vectors: sum, difference, scalar product, vectorial product. Moment of a force. Couple. Equivalent force systems. Graphical decomposition of forces and couples: decomposition of a force along two directions, decomposition of a force along three directions, transport of a force parallel to itself.

Statics and kinematics of rigid body
Definition of rigid body. Degrees of freedom of rigid bodies and generalized displacements. Infinitesimal rigid displacements. Principle of superposition. In-plane rigid displacements. Rotation centre. Virtual work principle. Cardinal equations of Statics.
External constraints: definition, kinematic and static classification. Kinematic classification of a rigid body. Systems of rigid bodies. Internal constraints: definition, kinematic and static classification. Centre of relative rotation among rigid bodies. Kinematic classification of rigid bodies. Fundamental theorems of kinematics.
Classification and modeling of structures. Mathematical modeling of external loads. Plane straight beams. Statically determinate structures. Determination of constraint reactions by analytical and graphical methods. Internal forces (axial force, shear force and bending moment) in plane beams. Differential equilibrium equations for beams. Diagrams of internal forces by analytical and graphical procedures. Analysis of truss structures by the method of joints (graphical and analytical procedures) and the method of Ritter’s sections.

Geometry of areas
Centroid of an area. First moment of area. Second moment of area. Parallel-axis theorem. Principal inertia axes. Central ellipse of inertia. Central core of inertia (graphical construction).

Expected results

Knowledge and understanding (Dublin descriptor 1)
Knowledge and understanding of theoretical and practical topics concerning the kinematics and statics of free and constrained rigid bodies, the study of plane beam systems idealized as assemblage of constrained rigid bodies, the analysis of truss structures and the evaluation of geometrical properties of cross-sections. This will be achieved through lecture attendance and the use of advanced textbooks.

Applying knowledge and understanding (Dublin descriptor 2)
The ability to apply theoretical knowledge to define a mathematical model of a real structural problem and to analyze the behavior of statically determinate structural systems by applying appropriate solution methods. In particular, the student must be able to solve statically determinate plane beam systems under prescribed loads by determining the constraint reactions and the diagrams of internal forces.

Making judgments (Dublin descriptor 3)
The ability to interpret the results obtained from the analysis of statically determinate structural systems (constraint reactions and diagrams of internal forces) and their application in the design practice.

Communication skills (Dublin descriptor 4)
The ability to: i) communicate theoretical knowledge by adopting a terminology specific to the Mechanics of Solids and Structures; ii) describe structural problems and related solution methods; iii) graphically represent and interpret the results obtained from the analysis of statically determinate structural systems.

Learning skills (Dublin descriptor 5)
The ability to learn the theoretical and applicative contents of the Course through lecture attendance and independent work. This will allow the student to undertake the study of related disciplines.

Course structure and teaching

Frontal lectures (hours/year in class): 36
Practical classes (hours/year in class): 24
Optional guided practical classes outside of class time (hours/year in class): 10

Calendar of teaching activities:
Week 1-4: Theoretical topics
Week 5: Practical classes
Week 6: Theoretical topics
Week 7: Practical classes
Week 8: Theoretical topics
Week 9: Practical classes
Week 10: Theoretical topics
Week 11: Theoretical topics and practical classes
Week 12: Practical classes

Student’s independent work

Student's independent work will consist of the following activities (90 hours):
- in-depth study, using textbooks, of the topics covered during the frontal lectures;
- solve practical examples concerning statically determinate beam systems, truss structures and geometry of areas;
- carry out homework assigned by the Lecturer and mandatory for admission to final exam.

Testing and exams

Learning will be verified at an intermediate and final stage.
The intermediate verification will consist of handing in mandatory homework for admission to the final verification phase. The homework can only be handed in by students who have achieved an attendance of not less than 70 percent (Art. 14 of the Didactic Regulations).
The final examination (profit exam) will consist of a written test including questions of either an applied (2 or 3) or theoretical (2 to 4) nature, and an oral examination on the topics covered in the Course.
The written test and the oral examination will be held in the same session. No books, notes, or electronic devices can be used during the written test.
The grade, expressed in thirtieths, will be awarded based on the level of achievement of the expected results according to the Dublin indicators.

Suggested reading materials

Theory:

-Giuseppe Muscolino, Giovanni Falsone, Introduzione alla Scienza delle Costruzioni. Statica e cinematica delle travi. Pitagora Editrice, Bologna, 1991.
-Paolo Casini, Marcello Vasta, Scienza delle Costruzioni. Quarta edizione. Città Studi, Novara, 2019.
-Elisa Guagenti, Fernanda Buccino, Elsa Garavaglia, Giorgio Novati, Statica. Fondamenti di meccanica strutturale, Terza Edizione, McGraw-Hill, Milano, 2009.

Applications:

-Erasmo Viola, Esercitazioni di Scienza delle Costruzioni. Vol. 1. Pitagora Editrice, Bologna, 1993.
-Sitografia di riferimento: http://www.unirc.it/didattica/scheda_persona.php?id=759