UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2022/2023
BACHELOR'S DEGREE (BSC)	BUILDING ENGINEERING, INNOVATION AND RETROFITTING
SUBJECT	STATICS
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50108-Edilizia e ambiente
CODE	06636
SCIENTIFIC SECTOR(S)	ICAR/08
HEAD PROFESSOR(S)	SPADA ANTONINO Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	85
COURSE ACTIVITY (Hrs)	65
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	2
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**SPADA ANTONINO** Wednesday 15:00 17:00 Stanza docente ed online a richiesta.

DOCENTE: Prof. ANTONINO SPADA

PREREQUISITES	Basic knowledge of Physics and Mathematics: matrices and vectors, solution of systems of algebraic equations, calculus of derivates and integrals.
LEARNING OUTCOMES	Knowledge and understanding. At the end of the course the student will be able to differentiate a statically determined structure from hypo- or hyper-static ones (hyper- or hypo-kinematic, respectively). The student will be able to determine the deformed shape of hyper-kinematic plane structures and govern the equilibrium in statically determined plane structures, obtained as an assembly of mono-dimensional elements. He will understand how internal forces distribute in the structure as a function of structural geometry and its support conditions. Applying knowledge and understanding. The student must be able to schematize a structure in terms of its geometry, kinematics, external actions and mechanical behavior. In particular: he must be able to classify a structure, obtained as an assembly of beams, as a statically determined or hypo- or hyper-static one; he must determine and govern the external and internal, global and local, equilibrium of a structure, and describe it numerically, analytically and graphically; he must be able to impose compatibility conditions according to the supports. Independency of judgment. The student will be able to independently evaluate: -the applicability conditions of structural models commonly applied to study real structures; -the mechanical adequacy of elements forming a structure. Communication skills. The student will learn the capability to communicate and express opinions about problems on the topics of the course. He will be able to hold conversations on the main topics of the discipline using appropriate language and instruments to mathematically represent the main mechanical phenomena. The student will acquire the skill to describe the mechanical and kinematical behavior of structures through tables, graphs, plots, and analytic and descriptive calculus reports. Learning ability. The student will learn the main principles of the mechanical analysis of structures. He will be able to: classify structures among the main groups, identifying its constraint conditions; write equilibrium and compatibility equations in the appropriate form for each studied class of structures; solve the system of equilibrium equations of the structure and furnish the response, both mechanical or kinematical; determine the response to simple or complex actions on a structure. All these knowledge will contribute to form the personal cultural baggage on mechanics of structures, and represent the basic education to continue engineering studies, increasing the aspects on the design of structures in following subjects.
ASSESSMENT METHODS	The exam can be hold in two different ways, with reference to the written tests. The first way is suggested for students who constantly follow the lessons and consists in two written in-itinere tests and a final oral exam. The second way is the classical written + oral exam form, at the end of the course. Evaluation criteria for written tests. In-itinere written tests consist in the solution of two exercises, based on the arguments of the first and second module of the semester, respectively. The first test aims at verifying the knowledge assimilated by the student to correctly classify the structures, to govern of the equilibrium of statically determined structures in terms of constraining reactions, to correctly trace the moved configurations of hyper-kinematic structures. The second test aims at verifying the capability of the student to determine internal forces of statically determined structures and geometric properties of plane areas. It consists in solving one exercise based on the Mechanics of Structures and an exercise based on the Theory of plane areas. The classical complete written exam consists, instead, in three exercises, whose arguments are based on the mechanical response of statically determined structures, on the on the kinematic of hyper-kinematic structures, on the geometric properties of plane areas. Each written test receives an evaluation out of 30. For each exercise of the test the maximum mark is known before starting the exam. The score is established by the teacher on the basis of the time needed to solve the exercise and the

	difficulty level of all the exercises. A student is admitted to the oral exam if the mark of the written test (the average of the two tests, if in-itinere) is at least equal to 18/30. Evaluation criteria for oral exam. The oral exam consists in a conversation with open questions on the topics of the course, and also aims at verifying the capabilities of the student to use one or more studied instruments to solve structural problems. The exams in structured in three questions at minimum, each one on a different topic. The scientific and methodologic accuracy of the exposition is also evaluated together with the knowledge of the topics. The oral exam is scored out of 30. The test is passed if the score is at least equal to 18/30. The total score of the student comes from the analytical mean of the written and oral exam scores. The total score is given according to the following scheme: Excellent (30-30 cum laude): really good knowledge of the arguments, really good and correct use of language, good analytical ability, the student is able to apply knowledge to solve proposed problems; Very good (26-29): good skill with the arguments, full use of the language, the student is able to apply knowledge to solve proposed problems; Good (24-25): basic knowledge of the main arguments; discrete use of language, with limited ability to independently apply the knowledge to the solution of proposed problems; Discrete (21-23): the student does not have a full competence with the main arguments of the course but he has the knowledge, sufficient use of language, poor ability to independently apply the acquired knowledge; Sufficient (18-20): minimal knowledge on the main topics of the course and of the technical language, very low or null ability to independently apply the acquired knowledge; Not sufficient: the student does not have an acceptable knowledge of the main topics of the course.
EDUCATIONAL OBJECTIVES	The goal of the course is to furnish the basic knowlegde on the Mechanics of structures. In the formulation of theories it will be made a focus on the fundamental relations: equilibrium, compatibility, principle of virtual work. A detailed study will be dedicated to kinematics and equilibrium of structures constituted by monodimensional beams. The student should demonstrate to have learned the basic concepts and reached an adequate level of knowledge on the specific topics. He must also demonstrate to be able to independently use the furnished instruments for the solution of simple problems and exemplary structural cases.
TEACHING METHODS	The course is held in the first semester of the second year and is structured in lessons, practice in classroom, and laboratory activities. Proposed exercises are of the same difficulty level of those in the final test. The learning method is based on a direct participation of the student during practical lessons, solving problems explained during theoretical hours, together with the teacher.
SUGGESTED BIBLIOGRAPHY	- P. Casini, M. Vasta, Scienza delle Costruzioni, qualsiasi edizione, Citta' Studi Edizioni. ISBN 978-88-251-7427-4 - C. Polizzotto, Scienza delle Costruzioni, qualsiasi edizione, ed. Cogras. - E. Viola, Esercitazioni di Scienza delle Costruzioni, vol.1, qualsiasi edizione, Pitagora editrice Bologna. ISBN 88-371-0665-3 - C. Comi, L. Corradi Dell'Acqua, Introduzione alla meccanica strutturale, qualsiasi edizione, McGraw-Hill. ISBN 9788838615412 - R. R. Craig, Jr, Mechanics of Materials, (any edition), John Wiley & Sons. ISBN 978-0-470-48181-3 - F. P. Beer, E. R. Johnston Jr, J. T. DeWolf, D. F. Mazurek, Statics and Mechanics of Materials, (any edition), McGraw-Hill. ISBN 978-0-07-339816-7

SYLLABUS

Hrs	Frontal teaching
2	Kinematics of rigid bodies. Internal and external supports.
2	Topological classification of structures.
3	Hyper-kinematic structures
2	The principle of virtual work.
4	Equilibrium of rigid bodies, of hyper-kinematic structures and statically determined structures
4	Indefinite equilibrium equations, discrete equilibrium equations and boundary equilibrium equations of plane structures. Diagrams of internal forces.
2	Truss structures
2	Geometric properties of plane areas: centroid, first and second moments of areas. Principal ellipse and kernel of inertia.

Hrs	Practice
2	Recalls of matrices and vectors, solution of systems of algebraic equations, calculus of derivates and integrals.
3	Forces. Moment of a force. Resultant of a system of forces.
3	Decomposition of a force or a moment. Distributed forces.
3	Deformed shapes of hyper-kinematic structures with one or mode degrees of freedom.
3	Deformed shapes of hyper-kinematic structures with one or mode degrees of freedom. Deformed shape projection method.
3	Evaluation of reaction forces in statically determined systems.
3	Diagrams of internal forces in statically determined systems.
2	Plane truss structures: the method of canonical nodes and Ritter’s method.
2	Geometric properties of plane areas: determination of centroid, principal moments of inertia, ellipse and kernel of plane areas

Hrs	Workshops
5	Interactive applications on the first stage of the design process of structures: modeling of geometry, supports and external actions.
5	Interactive applications on the first stage of the design process of structures: modeling of geometry, supports and external actions.
5	Interactive applications on the first stage of the design process of structures: structural calculus.
5	Interactive applications on the first stage of the design process of structures: structural calculus.