UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2017/2018
BACHELOR'S DEGREE (BSC)	MECHANICAL ENGINEERING
SUBJECT	MECHANICS OF MATERIALS AND THEORY OF STRUCTURES
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50301-Ingegneria dei materiali
CODE	06313
SCIENTIFIC SECTOR(S)	ICAR/08
HEAD PROFESSOR(S)	DI PAOLA MARIO Professore a contratto in quiescenza Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	9
INDIVIDUAL STUDY (Hrs)	144
COURSE ACTIVITY (Hrs)	81
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	2
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**DI PAOLA MARIO** Monday 10:00 13:00 Area strutture, primo piano. Wednesday 15:00 17:00 Area strutture, primo piano.

DOCENTE: Prof. MARIO DI PAOLA

PREREQUISITES	Students who attend the course know and is able to manage the basic concepts in mathematics, linear algebra, geometry and rational mechanics.
LEARNING OUTCOMES	Knowledge and understanding ability: • The student at the end of the course will have 'knowledge of issues inherent in the mechanics of materials and structures. He will have also confidence with concepts related to the state of strain and stress, moreover, will manage linear elastic-linear constitutive relationships typical of each structural material. The student will know the main relationships that govern the response of structural systems in terms of displacements, trains and stresses. In particular, the student will be able to understand the structural response of beams subject to simple and complex external agencies. Capacity to apply knowledge and understanding: • The student will be able to: classify assembled beams as structural systems with degree of hypo-, iso-, hyper-immobility (structure statically determined or undetermined). Assess and mastering the balance equilibrium equations in terms of: external and internal forces, global and local form. Assess the equilibrium of a structure, and describe it, numerically, analytically and graphically. Impose congruence and compatibility conditions for solids and structures. Know the physical and mechanical properties of solid materials such as strength, thermal and elastic stiffness. Know how to determine principal stresses and principal directions at a point and describe them, either analytically or graphically. Know how to determine the stress diagrams for a cross section of a beam (Saint Venant solid) subjected to simple and composed external load of and describe them graphically. Compute displacements, elastic and thermal deformations of the elementary structures; Determine statically indeterminate unknowns and the states of stress and displacement field of statically undetermined structures; determining critical loads and Safety condition for buckling of rectilinear rods loaded at the tip. Making judgments: • The student will be motivated to critical thinking and self-evaluation about: - Validity and limits of structural modeling including the limits of the phenomenological models that characterize linear elastic behavior of materials and structures. - The conditions of applicability of structural models, which are adopted forde scribing actual structures; - The areas of use of the technical theory of the beam and the related criteria structural safety: - Adequacy of static structural systems, appropriate boundary conditions and optimum size and shape of beam cross sections of beam structures. • Communication skills The student will acquire the ability to communicate and express issues about the topics of the course. During the lectures and at the exercises sections considerable attention will be placed at a rigorous mode of communication, such as to enable the students to hold conversations on topics relating to fundamentals of the discipline (state of stress and strain in solids and in structures, structural classification, the constraints reactions and conditions of maximum stress) or through a proper scientific terminology, and to tools of the mathematical representation of the main mechanical phenomena described. Students will encouraged to do technical discussion in public and solicited discussion among students on topics covered in the course. Learning skills: • The student will learn the basics of mechanics of solids and structures. He will learn the basics of the mechanical behavior of solid materials, including material properties, such as stiffness and strength. These knowledge will contribute to the formation of his wealth of knowledge of mechanics applied to solid materials and structures. These skills constitute also part of the basic engineering education that will allow to continue their engineering studies.
ASSESSMENT METHODS	Written and oral final test. The vote is expressed in thirtieths with possible laude, according to the following scheme: Excellent (30-30 with distinction): Excellent knowledge of the topics and very good language skills. Good analytical skills. The student is able to use the knowledge he/she has acquired to solve problems. Very good (26-29): Good grasp of the topics. Sound language skills. The student is able to use the knowledge he/she has acquired to solve problems. Goog (24-25): Basic knowledge of the main topics. Fair language skills with limited ability to independently use the knowledge acquired to solve problems. Satisfactory (21-23): The student lacks a firm grasp but has some knowledge of the main topics. Satisfactory language skills. Low ability to independently use

	the knowledge acquired. Sufficient (18-20): Minimum basic knowledge of the main topics and technical language. Very low or no ability to independently use the knowledge acquired. Fail: The student does not have an acceptable knowledge of the topics.
EDUCATIONAL OBJECTIVES	Primary objective of the course is to provide the basic knowledge of the mechanics of solids together with elements of the theory of structures, developed specifically refered to the application in the field of chemical engineering and materials. In the formulation of the theoretical assumptions (mechanics of continuum solids and beam theory) focus on fundamental relations: balance laws, compatibility relations, principle of virtual work, constitutive equations. In view of applications, the beam theory is widely developed in a specific part of the lecture course; while, in parallel, the Exercise course develops the numerical-applied aspects of simple structural systems From a methodological point of view, the course is as an essential hub among the basic scientific courses (mathematics, geometry, physics and rational mechanics) employing the same formal rigor, and the subsequent courses more closely related to engineering design and strength check of materials and structures. Final verification develops according to a written exam and to an oral interview in which the student must demonstrate that he has mastered the basics concepts and he has achieved an adequate level of knowledge of the specific topics. The student must also demonstrate that he is able to use independently the tools provided in solving simple problems but paradigmatic of structural cases. The learning mechanism is based on direct involvement of students in practical exercises held in the classroom.
TEACHING METHODS	60 hours lectures, 36 hours excercises
SUGGESTED BIBLIOGRAPHY	• Viola E., Scienza delle Costruzioni vol 1 e 3, Pitagora, 1990-1992. • Viola E., Esercitazioni di Scienza delle Costruzioni, Pitagora, 1988. • Di Paola M., Pirrotta A., Lezioni di Scienza delle Costruzioni, Dispense del corso.

SYLLABUS

Hrs	Frontal teaching
1	Introduction to Mechanics of solids and structures
6	Constraints and reaction of constraints, statically determined structures
6	Internal forces in beams
4	Deformable continuum static
3	Deformable continuum kinematics
4	Theory of elasticity
2	Energetics concepts about deformation
2	The De Saint Venant's beam
10	Axial force, Bending Moment, Shear
3	Torsion
2	Eccentric axial force
3	Statically determined and undetermined trusses
4	Fundamental identity of mechanics and energetic theorems
3	Strength criteria
5	Solution of statically undetermined structures
2	Buckling problems, Eulerian critical load

Hrs	Practice
3	Recalls about vectors theory, equivalent and balancing system
3	Constraints and constrained structures, kinematics and static classification of structures, solution of statically determined structures
4	Geometry of areas
3	Internal forces diagrams of statically determined structures
3	Solution of statically determined structures with the graphic method
3	Excercise on state of stress and Mohr circles
3	Theory of Navier-Bernoulli: deformation state and flexural curvature for statically determined and undetermined structures
1	Exercises about axial force on De Saint Venant's beam
3	Excercises about pure simple bending and combined axial force and bending on De Saint Venant beam
2	Exercises about torsion on De Saint Venant beam
2	Exercices about biaxial bending on De Saint Venant beam
6	Solution of statically undetermined structures