UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2020/2021
MASTER'S DEGREE (MSC)	BUILDING ENGINEERING
SUBJECT	STRUCTURAL MODELLING
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50355-Edilizia e ambiente
CODE	21102
SCIENTIFIC SECTOR(S)	ICAR/08
HEAD PROFESSOR(S)	GIAMBANCO GIUSEPPE Professore Ordinario Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	98
COURSE ACTIVITY (Hrs)	52
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**GIAMBANCO GIUSEPPE** Monday 8:30 11:30 Laboratorio NDE - Edificio 8 Viale delle Scienze

DOCENTE: Prof. GIUSEPPE GIAMBANCO

PREREQUISITES	Mechanics of Solids; Beam theory; Strength criteria; Matrix and vectorial calculus; Stress and Strain state; Constitutive equations for ductile and brittle materials; Methods of Structural Analysis; Basic knowledge of computer programming by advanced languages like Matlab, Python and R.
LEARNING OUTCOMES	Knowledge and understanding: knowledge of the theoretical principles of computational mechanics. Numerical techniques for the solution of partial differential equations. General overview of the structural organism finalized to the modeling by using the finite element method. Applying knowledge and understanding: identification of structural elements, physical-mechanical characterization and modeling technique for the structural response in presence of extern loads. Pre-processing, solution and post-processing of results. Making judgement: evaluation of the numerical analysis, assessment of the model and results elaboration. Communication: capability to show with text and plots the numerical analysis of the structure. Report preparation according to the instructions of the Italian rules. Lifelong learning skills: possibility to learn new methods of structural analysis for static and dynamic, linear and nonlinear studies. Capability to apply the commercial numerical codes developed according to the Italian regulation for new and existing constructions.
ASSESSMENT METHODS	The exam consists of the oral part on the arguments of the course and of the presentation of a structural analysis developed during the course by a self-made numerical code. The oral examination requires the knowledge of the principal variational theorems of mechanics, basic principles of the finite element method with the aim of modeling structures under static or dynamic conditions, modeling techniques for 2D and 3D structures with standard finite elements. The oral test shall be considered to have a positive result if the student satisfies at least two questions on the arguments presented along the course and if the assigned homework is correct and well presented. The threshold of sufficiency will be achieved when the student has demonstrated an acceptable knowledge and understanding of theoretical and practical tools, adequate exposure skills and minimal ability to apply the acquired knowledge independently. The vote is expressed in thirtieths with possible praise, according to the scheme reported at the bottom of the degree program homepage, i.e. "Metodi di valutazione".
EDUCATIONAL OBJECTIVES	Knowledge of basic concepts of computational mechanics and modeling of the structures in static and dynamic conditions by means of finite element method.
TEACHING METHODS	Frontal lessons, practice in classroom. Teaching and learning in classroom is supported by overhead slides (the pdf version of the slides is provided to all the students enrolled in the class on the teaching material section). Computer implementation of structural analysis methods.
SUGGESTED BIBLIOGRAPHY	J.K. Bathe, Finite Element Procedures, Prentice Hall, 1996 The finite element method : basic concepts and applications with MATLAB, MAPLE, and COMSOL, CRC Press, 2017.

SYLLABUS

Hrs	Frontal teaching
3	Weak form of equilibrium, minimum of potential energy theorem
2	d'Alembert principle and the Hamilton theorem.
1	Geometrical discretization and algebraic form of equilibrium equations
3	Shape functions, numerical integration
4	Truss and beam finite elements
4	Isoparametric finite elements 2D, triangular and quadrilateral elements
2	Local and global reference systems, elements assembly
2	Finite elements in dynamics.
2	Modal decomposition
2	basic concepts of non linear behavior of materials
3	Finite elements in plasticity

Hrs	Practice
4	Introduction to Matlab programming, IDE, vectors and matrices operations, print and plot.
4	Beam element implementation in Matlab
3	Frame modeling
2	Frames modal analysis

Hrs	Practice
4	Triangular finite element implementation
3	Wall modeling with 2D triangular finite elements, accuracy of the mesh and mesh refinement.
2	The Newton-Raphson method, Matlab implementation
2	Commercial structural codes an overview