UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria		
ACADEMIC YEAR	2020/2021		
MASTER'S DEGREE (MSC)	BUILDING ENGINEERING		
INTEGRATED COURSE	BUILDING STRUCTURES IN SEISMIC ZONE - INTEGRATED COURSE		
CODE	21103		
MODULES	Yes		
NUMBER OF MODULES	2		
SCIENTIFIC SECTOR(S)	ICAR/09		
HEAD PROFESSOR(S)	CAVALERI LIBORIO	Professore Ordinario	Univ. di PALERMO
OTHER PROFESSOR(S)	CUCCHIARA CALOGERO	Professore Associato	Univ. di PALERMO
	CAVALERI LIBORIO	Professore Ordinario	Univ. di PALERMO
CREDITS	12		
PROPAEDEUTICAL SUBJECTS			
MUTUALIZATION			
YEAR	1		
TERM (SEMESTER)	2° semester		
ATTENDANCE	Not mandatory		
EVALUATION	Out of 30		
TEACHER OFFICE HOURS	**CAVALERI LIBORIO** Thursday 15:00 17:00 studio personale **CUCCHIARA CALOGERO** Tuesday 12:00 14:00 Presso stanza del docente. Edificio 8 Dipartimento di Ingegneria 2° piano Thursday 12:00 14:00 Presso stanza del docente. Edificio 8 Dipartimento di Ingegneria 2° piano		

DOCENTE: Prof. LIBORIO CAVALERI

PREREQUISITES	Students are requested to know reinforced concrete cross-section behaviour/ analysis, frame structure analysis, reinforcement design for beam/column elements.
LEARNING OUTCOMES	Knowledge and understanding: Basic aspects of the structural behaviour under seismic actions of ordinary r.c. framed structures and ordinary masonry structures Applying knowledge and understanding: Design of ordinary r.c. framed structures and ordinary masonry structures a) R.C. framed structures: -prediction of response, -structural safety, -technical codes, -design methods for dissipative structures b) Masonry structures: - definition of the mechanical characteristics of materials - formulation of analysis models - load assign and calculus of internal forces - structural safety - technical codes Making judgments: Design of ordinary r.c. framed structures Communication: Capacity for describing design methods and safety assessment of r.c. structures and methods for the safety assessment of ordinary masonry structures Learning skills: Seismic design of ordinary and non-ordinary structures made of materials different from masonry and reinforced concrete
ASSESSMENT METHODS	Oral test: it has the aim to know the capacity of students to solve the problems that will be proposed (questions about the design strategies of ordinary r.c. framed structure in seismic zones with a specific connection to the capacity design will be proposed; the design criteria of masonry structures will be an object of further questions) and to know the capability of using a proper technical language while speaking. 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".
TEACHING METHODS	Classroom lessons, exercises, laboratory activities

MODULE
DESIGN WORKSHOP

Prof. CALOGERO CUCCHIARA

SUGGESTED BIBLIOGRAPHY

Dispense del corso/ Course notes
Nuove Norme Tecniche per le Costruzioni - DM 17 gennaio 2018.
Circolare n. 7, di applicazione NTC 2018 del 21 Gennaio 2019.
Eurocode 8 Design of structures for earthquake resistance Part 1: General rules, seismic actions and rules for buildings
Eurocode 8 Design of structures for earthquake resistance Part 3: Assessment and retrofitting of buildings
E. Cosenza, G. Maddaloni, G. Magliulo, M. Pecce, R. Ramasco - Progetto antisismico di edifici in c.a. – Ed. Iuss Press.
A. Ghersi, P. Lenza – Edifici antisismici in cemento armato – Dario Flaccovio Editore
E. Cosenza, G. Manfredi, M. Pecce – Strutture in cemento armato – Ed. Hoepli
N. Augenti. Il calcolo sismico degli edifici in muratura. Ed. Utet., Torino, 2000
L. Cavaleri, V. Radice - Specificita' nella valutazione della capacita' delle strutture murarie di nuova costruzione, Aracne Editrice, 2012.
Michele Vinci: Metodi di calcolo e tecniche di consolidamento per edifici in muratura - III EDIZIONE. Flaccovio Editore.

AMBIT	50355-Edilizia e ambiente
INDIVIDUAL STUDY (Hrs)	98
COURSE ACTIVITY (Hrs)	52

EDUCATIONAL OBJECTIVES OF THE MODULE

The course focuses on the structural design of seismic-resistant buildings, based on knowledge of the most recent criteria and techniques for designing and evaluating the seismic response of reinforced concrete and masonry framed buildings, addressed in the first part of the course. The course provide. criteria, methodologies and technical expertise finalized to confer judgment ability in the development of design of new structures, starting to the choice of the most appropriate structural typology or the strengthening strategies for existing structures . All the activities are developed in framework of current structural performance based design codes regarding the construction materials, techniques and loads, with reference to serviceability and Ultimate limit states in order to ensure performance and safety levels

SYLLABUS

Hrs	Frontal teaching
3	The Displacement Method for Framed Structures; shear type frame; Distribution factors in bending and shear
2	Structural scheme of aseismic buildings; behavior of different structural typology; Principles and requirements of structure behavior in seismic zone. Limit states and design performance. Plan and height Irregular structures
4	Structural pre-dimensioning of reinforced concrete sections of beams, columns and foundations under gravity load and seismic actions.
7	Design and reinforcement detailing of reinforced concrete beams, columns and Beam-Column Joints according to capacity design. The influence of masonry infilled reinforced concrete frames on hierarchy of resistance criteria. Beam, Column and Joints detailing for ductility class CD"B" and CD"A".
4	Structural scheme of aseismic masonry buildings; Foundamentals of structural design for masonry building. Limit states and design performance.
2	Design shear and compressive strength of masonry
4	Simplified design of masonry buildings
2	Analytical modeling of masonry structures in seismic areas

Hrs	Practice
8	Software for static and dynamic linear analysis of spatial framed structures
6	Software for non- linear static analysis of spatial framed structures
5	Software for linear static and dynamic analysis of spatial masonry structures
5	Software for non-linear static analysis of spatial masonry structures

MODULE
ANALYSIS METHODS AND PROJECT CRITERIA

Prof. LIBORIO CAVALERI

SUGGESTED BIBLIOGRAPHY

G. Muscolino. Dinamica delle strutture. – Ed. McGraw Hill (2001)
L. Petrini et al. Criteri di progettazione antisismica degli edifici. - Ed. Iuss Press, Pavia, 2004.
E. Cosenza, G. Maddaloni, G. Magliulo, M. Pecce, R. Ramasco - Progetto antisismico di edifici in c.a. – Ed. Iuss Press.
A. Ghersi, P. Lenza – Edifici antisismici in cemento armato – Dario Flaccovio Editore
E. Cosenza, G. Manfredi, M. Pecce – Strutture in cemento armato – Ed. Hoepli
N. Augenti. Il calcolo sismico degli edifici in muratura. Ed. Utet., Torino, 2000
L. Cavaleri, V. Radice - Specificita' nella valutazione della capacita' delle strutture murarie di nuova costruzione, Aracne Editrice, 2012.

AMBIT	50355-Edilizia e ambiente
INDIVIDUAL STUDY (Hrs)	98
COURSE ACTIVITY (Hrs)	52

EDUCATIONAL OBJECTIVES OF THE MODULE

The aim of the course is to create experts in the seismic design of ordinary r.c. framed and masonry structures. The course gives the basis for the structural detail design, aimed to obtain ductility, and the safety assessment criteria requested for the above type of structures in seismic zones.

SYLLABUS

Hrs	Frontal teaching
4	Seismology basics: the origin of earthquakes, seismic waves, intensity measure scales of earthquakes, seismic hazard. Interaction soil-structure and wave amplification. Elastic response spectrum and modal analysis. Design spectra. Ductility and behaviour factor.
4	Demand spectrum Multi-modal dynamic analysis, Demand spectrum uni-modal dynamic analysis, pushover analysis
4	Seismic weight, mass barycentre, stiffness barycentre, distribution of the seismic forces for framed structures with rigid storeys
4	Framed reinforced concrete ductility: materials, cross-sections, elements and structure, ductility class and connected behaviour factors
4	Capacity design: columns, beams, joints
3	Physical and mechanical characteristics of masonry: mortar, artificial and natural units. Laboratory tests
2	Structural system. Level and distribution of the vertical loads, level and distribution of the seismic load. System modeling by equivalent frames.
3	Safety assessment by the semi probabilistic limit state method. Global safety assessment, local safety assessment, shear, bending and vertical forces in the walls. Safety assessment of masonry beams.

Hrs	Practice
3	Seismology basics: the origin of earthquakes, seismic waves, intensity measure scales of earthquakes, seismic hazard. Interaction soil-structure and wave amplification. Elastic response spectrum and modal analysis. Design spectra. Ductility and behaviour factor.
3	Demand spectrum Multi-modal dynamic analysis, Demand spectrum uni-modal dynamic analysis, pushover analysis
3	Seismic weight, mass barycentre, stiffness barycentre, distribution of the seismic forces for framed structures with rigid storeys
3	Framed reinforced concrete ductility: materials, cross-sections, elements and structure, ductility class and connected behaviour factors
3	Capacity design: columns, beams, joints
3	Physical and mechanical characteristics of masonry: mortar, artificial and natural units. Laboratory tests
3	The masonry structural system. Level and distribution of the vertical loads, level and distribution of the seismic load. System modeling by equivalent frames.

3	Safety assessment by the semi probabilistic limit state method. Global safety assessment, local safety assessment, shear, bending and vertical forces in the walls. Safety assessment of masonry beams.