



COURSE: Earthquake Engineering

ACADEMIC YEAR: 2019/20

TYPE OF EDUCATIONAL ACTIVITY: Basic

TEACHER: Donatello Cardone

e-mail: donatello.cardone@unibas.it

web:

phone: 0971205054

mobile (optional):

Language: Italian

ECTS: 9

n. of hours: 81

Campus: Potenza,
School of Engineering:
Program: Civil Engineering,
Engineering for the Environment
and Territory

Semester: II

EDUCATIONAL GOALS AND EXPECTED LEARNING OUTCOMES

Knowledge: Understanding of the seismic response of buildings and bridges. Understanding of the seismic response and performances of structures with seismic isolation.

Skills: Ability to model and analyze complex structures such as multi-storey buildings and multi-span bridges. Ability to design structures (especially buildings) located in high seismicity regions.

PRE-REQUIREMENTS

- Fundamentals of Structural Engineering, with particular attention to reinforced concrete structures,
 - Basic knowledge and use of finite element programs for structural analysis (eg SAP2000).
-

SYLLABUS

Part 1. SEISMIC DYNAMIC OF STRUCTURES (20 hrs): (i) Dynamic properties of structures, (ii) Degrees of freedom and structural discretization methods, (iii) Equations of motion, (iv) modeling of structures as elementary systems, (v) Non-linear systems, (vi) Ductility ratio, (vii) Classification of earthquakes, (viii) elastic, non-linear and design response spectra, (ix) Continuous systems, (x) seismic dynamics of systems with multi-degrees of freedom, (xi) Modal analysis, (xii) Linear and non-linear methods of analysis, (xiii) Simplified design approaches.

Part 2. STRUCTURAL DUCTILITY (10 hrs): (i) Seismic behavior of masonry buildings, (ii) local and global ductility, (iii) Dissipating capacity and damage of reinforced concrete structures, (iv) Seismic behavior of framed and wall buildings, (v) Construction details, (vi) Seismic behavior of bridges.

Part 3. ANTI-SEISMIC DESIGN OF STRUCTURES (30 hrs): (i) The Italian seismic code (NTC 2008): Safety requirements, testing criteria, definition of seismic action, general design criteria, (ii) Methods of analysis: linear dynamic analysis, linear and non-linear static analysis, (iii) design rules for reinforced concrete buildings.

Part 4. STRUCTURAL MODELING (10 hrs): (i) Introduction to the finite element method, (ii) dynamic and kinematic degrees of freedom, (iii) modeling and analysis of reinforced concrete buildings, (iv) modeling of bridges, (v) modeling of the seismic action, (vi) verification of results.

Part 5. INNOVATIVE SEISMIC PROTECTION TECHNIQUES (10 hrs): (i) passive, semi-active and active control of structural vibrations, (ii) dissipation of energy: fundamentals, technologies for energy dissipation, examples of application, (iii) Seismic isolation: strategies for seismic isolation, currently used isolation systems, mechanical properties of currently used isolation systems, performance requirements of isolated structures, methods of design and analysis of buildings and bridges with seismic isolation, construction details, examples of application, seismic code aspects.

Part 6. TUTORIAL DESIGN (10 hrs): Design of a multi-storey building with reinforced concrete framed structure.

TEACHING METHODS

The course is organized as follows:



-
- Theoretical lessons (65 hrs);
 - Classroom tutorials (20 hrs)
 - Laboratory tutorials (5 ore).
 - Project Homework

EVALUATION METHODS

The exam consists of three tests:

- Written test, dealing with the content of the first part of the course (Dynamics of Structures). The estimated time for the test is 2 hours.
- Discussion of a project homework (max 3 person for group), dealing with the design of a RC frame building with either fixed-base or base-isolated.
- Oral examination.

TEXTBOOKS AND ON-LINE EDUCATIONAL MATERIAL

1. A. Chopra, Dynamics of Structures–Theory and Applications to Earthquake Engineering, Prentice Hall, 1995.
2. G.G. Penelis, A.J. Kappos, Earthquake Resistant Concrete Structures, E&F Spon, London, 1997.
3. A. Ghersi, P. Lenza, Edifici Antisismici in cemento armato, Flaccovio editore, 2009.
4. Skinner RI, Robinson WH, Mc Verry GH (1993) An Introduction to Seismic Isolation. John Wiley & Sons Ltd.

INTERACTION WITH STUDENTS

Office hours: Wednesday from 11am to 13am, study n. 8, third floor. The Professor can be contacted by e-mail.

EXAMINATION SESSIONS (FORECAST)¹

19/02/2020, 25/03/2020, 13/05/2020, 24/06/2020, 22/07/2020, 14/10/2020, 11/11/2020, 2/12/2020

EVALUATION BOARD

Riportare la commissione inserita nella scheda in lingua italiana

SEMINARS BY EXTERNAL EXPERTS YES NO

FURTHER INFORMATION

In the academic year. 2019/2020, two integrative teaching modules, 9 hours each, will be provided by a visiting professor from New Zealand. The tentative title of the two teaching modules is as follows: "Displacement approaches for the seismic design of structures", "Evaluation and improvement of seismic performance of non-structural elements"

¹ Subject to possible changes: check the web site of the Teacher or the Department/School for updates.