COURSE DESCRIPTION
seismic micro-zoning

SSD: GEOFISICA DELLA TERRA SOLIDA (GEO/10)

DEGREE PROGRAMME: GEOSCIENZE PER L'AMBIENTE, LE RISORSE E I RISCHI NATURALI (P73)
ACADEMIC YEAR 2025/2026

COURSE DESCRIPTION

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GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: NOT APPLICABLE
MODULE: NOT APPLICABLE
TEACHING LANGUAGE: ITALIANO
CHANNEL:
YEAR OF THE DEGREE PROGRAMME: II
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER I
CFU: 6

REQUIRED PRELIMINARY COURSES

there are no prerequisites

PREREQUISITES

No specific prerequisites are required, but students are expected to have gained a foundational understanding of topics such as seismology, geology, computer science, statistics, and physics during their undergraduate studies.

LEARNING GOALS

This course aims to provide students with a comprehensive understanding of seismic microzonation in Italy. Educational objectives encompass grasping fundamental seismological principles and Italian seismic regulations. Furthermore, they will be able to apply this knowledge through practical microzonation projects, analysing real-life cases and assessing practical implications for community seismic safety and urban planning. Students will develop skills in using

GIS tools for data visualization and analysis in microzonation, along with an awareness of ethical and regulatory responsibilities in the field of seismic safety. Additionally, collaboration with local authorities and organizations actively involved in seismic microzonation will be encouraged for practical application of acquired knowledge.
In summary, this course aims to prepare students to become competent professionals in local seismic risk assessment and to contribute responsibly to the safety of Italian communities within an interdisciplinary context and in compliance with current regulations.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

Students will gain a solid understanding of the fundamental principles of seismic microzonation, including Italian seismic regulations. This knowledge will encompass the geological, geotechnical, and seismological aspects involved in assessing the seismic characteristics of an area. They will be able to analyze and interpret geological and seismic data and fully comprehend the practical implications of seismic microzonation for community safety and urban planning.

Applying knowledge and understanding

Students will apply this knowledge to implement seismic microzonation concepts in practice through real-world projects. They will be able to use GIS tools for visualizing and analyzing seismic microzonation data, developing practical skills in applying these techniques for local seismic risk assessment purposes. Additionally, they will effectively communicate the results of their analyses, both in written and oral forms, tailoring their language to the target audience. All of this will be conducted in compliance with regulations and ethical responsibilities in the field of seismic safety, ensuring effective collaboration with local authorities and other professionals involved in seismic microzonation.

COURSE CONTENT/SYLLABUS

Introduction to Earthquakes:

Source spectrum, magnitude, and moment, stress drop; seismic waves, dispersion of seismic waves, Gutenberg-Richter law; Intensity.

Time Series:

Discrete Fourier transform, filtering, convolution, sampling, and aliasing, data windows, and spectral analysis. Seismological applications and examples.

Amplification and Seismic Hazard:

Strong-motion measurements, strong-motion parameters, site effects, and reference earthquake, earthquake source identification and evaluation; Deterministic and probabilistic seismic hazard analysis.

Italian Seismicity:

Introduction to Italian seismicity and its historical and geographical distribution. Major historical earthquakes in Italy and their impact. Characteristics of earthquakes in Italy, including seismic parameters and recent trends.

Introduction to Seismic Microzonation:

Regulatory references; Definitions; Principles and elements of seismic microzonation; Procedures for conducting surveys, Compliance with seismic building regulations in Italy. Seismic retrofit projects and their impact on seismic safety.

Resources for Microzonation:

Data available online for seismic microzonation, with a focus on INGV, ISPRA, etc. Open-source software for local amplification studies and surface wave analysis, including spectral ratios. Practical examples of using resources for seismic microzonation.

Analysis of Surface Waves:

Two-dimensional Fourier transform and FK spectrum; Frequency-Time Representation of Surface Waves (FTAN); Spectral analysis of surface waves (SASW); Inversion concepts; Multichannel analysis of surface waves (MASW); MASW examples; real data applications with open-source Geopsy software.

Local Amplification Analysis:

Spectral ratios (H/V and Nakamura method) for site amplification studies. Modeling of one-dimensional stratified subsurface. Practical exercises in local amplification analysis and subsurface modeling.

Microzonation Project:

Introduction to seismic microzonation project. Introduction to the QGIS environment; Use of QGIS for seismic microzonation using the CNR's MzStools plugin. Students work on a microzonation project in groups in QGIS. Data collection, analysis, and report writing. Presentation of results at the end of the course

READINGS/BIBLIOGRAPHY

Suggested readings:

Bramerini, F., Di Pasquale, G., Naso, G. and Severino, M., 2008. Indirizzi e criteri per la microzonazione sismica. *Presidenza Consiglio dei Ministri, DPC, Roma*.

Roca, A. and Oliveira, C. eds., 2002. *Earthquake microzoning*. Springer Science &Business Media.

Dowrick, D.J., 2003. *Earthquake risk reduction*. John Wiley &Sons.

Foti, S., Lai, C.G., Rix, G.J. and Strobbia, C., 2014. *Surface wave methods for near-surface site characterization*. CRC press.

Yoshida, N., 2015. Seismic ground response analysis (Vol. 36). Dordrecht: Springer Netherlands.

Lay, T. and Wallace, T.C., 1995. Modern global seismology. Elsevier.

TEACHING METHODS OF THE COURSE (OR MODULE)

lectures (3 CFU)

labs (3 CFU)

EXAMINATION/EVALUATION CRITERIA

a) Exam type

☑ Written

☑ Oral

- [x] Project discussion
- [ ] Other

In case of a written exam, questions refer to

- [x] Multiple choice answers
- [x] Open answers
- [x] Numerical exercises

b) Evaluation pattern

The final grade will be determined by averaging the results of the midterm exams programmed for the 23/10/25 and for the 27/11/25 and the final oral exam