University of Pavia

IUSS School of Advanced Studies

Civil Engineering for Mitigation of Risk from Natural Hazards

# SEISMIC HAZARD AND ENGINEERING SEISMOLOGY

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| **Institutions:** | University of Pavia and IUSS Pavia |
| **Curriculum:** | ROSE |
| **Term:** | Academic Year 2023/2024 – 2nd Semester |
| **Credits (CFU):** | 6 |
| **Instructor:** | Prof. Valerio Poggi (vpoggi@ogs.it) |
| **Teaching assistant:** | Lana Todorovic |
| **Class duration:** | March 4th – March 29th, 2024 (36 hours of classes + 15 hours of lab/tutoring) |
| **Classroom:** | Broletto, Piazza della Vittoria 15 |

**Goals and course structure**

The course aims at providing the students with the essential knowledge and skills to face most common seismology problems in engineering and applied geophysical practice. The course splits into two main blocks. In the first module, topics of engineering interest are discussed, such as intensity measures, ground motion prediction equations, earthquake occurrence analysis, seismotectonics, seismic hazard assessment (deterministic and probabilistic); in the second module hints of theoretical seismology are provided, with a focus on wave propagation and source representation issues.

**Practicum**

The course is complemented by laboratory in-class activity, a number of selected readings and homework assignments, with a focus on the use of the computer to solve simple problems of seismological interest.

**Prerequisites**

Advanced calculus and linear algebra are useful, although not a requirement for the course. The course lab will make use of Python language for some exercises, therefore some familiarity with computer programming is recommended.

**Qualification**

The course is concluded by both a practical exercise and a written exam. The practical part consists in the discussion of a personal project developed during the laboratory hours of the course. The student is expected to present his elaboration to the class and to the examiner by means of a brief slide show (10min. plus some time for questions). The written exam consists of a test with multiple questions about specific topics, freely excerpt from the course program.

**Grading**

| ACTIVITIES | PERCENTAGE |
|---|---|
| Class participation | 10% |
| Project presentation | 20% |
| Final Exam | 70% |

**Reference textbooks**

- Stein S., and M. Wysession. An Introduction to Seismology, Earthquakes, and Earth Structure. 1st ed. Malden, MA: Blackwell, September 2002. ISBN 9780865420786.
- Kramer, S.L., Geotechnical Earthquake Engineering, Prentice Hall, 1996, ISBN 0133749436
- Lecture notes, scientific articles and tutorials will be provided throughout the course

**Note**
The instructor reserves the right to make changes to this syllabus as necessary.

**Course schedule**

| Week | Date | Lecture hours From__ To__ | Tutorial hours From__ To___ | Subject | Tot h |
|---|---|---|---|---|---|
| 1 | 4/03 | 09.30-12.30 BROLETTO AULA 1.16 | -- | Course Introduction; Earthquakes and faults | 3 |
| | 5/03 | 09.30-12.30 BROLETTO AULA 1.16 | -- | Seismotectonics; Ground motion measurements | 3 |
| | 6/03 | 09.30-12.30 BROLETTO SALA RIUNIONI | -- | Earthquake size: intensity and magnitude | 3 |
| | 7/03 | 09.30-12.30 BROLETTO SALA RIUNIONI | -- | Seismic catalogues; Seismic occurrence analysis | 3 |
| | 8/03 | 09.30-12.30 BROLETTO SALA RIUNIONI | -- | Ground motion prediction Equations | 3 |
| 2 | 11/03 | 09.30-12.30 BROLETTO SALA RIUNIONI | -- | DSHA and PSHA | 3 |
| | 12/03 | -- | 09.30-12.30 BROLETTO AULA 1.17 | PSHA Modeling Laboratory | 3 |
| | 13/03 | -- | 09.30-12.30 BROLETTO SALA RIUNIONI | PSHA Modeling Laboratory | 3 |
| | 14/03 | -- | -- | -- | -- |
| | 15/03 | -- | 09.30-12.30 BROLETTO SALA RIUNIONI | PSHA Modeling Laboratory | 3 |
| 3 | 18/03 | 09.30-12.30 BROLETTO AULA 1.17 | -- | Wave types and seismograms | 3 |
| | 19/03 | 09.30-12.30 BROLETTO AULA 1.17 | -- | Seismic source representation | 3 |
| | 20/03 | 09.30-12.30 BROLETTO AULA 1.17 | -- | Wave propagation in heterogenous earth | 3 |
| | 21/03 | 09.30-12.30 BROLETTO AULA 1.17 | -- | Earthquake location and Inverse problems | 3 |
| | 22/03 | -- | 09.30-12.30 BROLETTO AULA 1.15 | Exercises – Revision / Questions | 3 |

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| 4 | 25/03 | 09.30-12.30<br>BROLETTO AULA 1.15 | -- | Seismometers and seismic networks | 3 |
| | 26/03 | 09.30-12.30<br>BROLETTO AULA 1.15 | -- | Ambient vibration seismology | 3 |
| | 27/03 | -- | 09.30-12.30<br>BROLETTO AULA 1.15 | Exercises – Revision / Questions | 3 |
| | 28/03 | -- | -- | -- | -- |
| | 29/03 | 09.30-12.30<br>BROLETTO AULA 1.15 | -- | **Exam** | 3 |

* Additional tutorial and revision hours will be agreed with students during the course.