GEM Models and OpenQuake Engine Training

This course, part of the Doctoral Programme in Earthquake Engineering at IUSS Pavia, is organised by the Global Earthquake Model (GEM) Foundation, and aims to provide a comprehensive overview of state-of-the-art methods and models for seismic hazard, exposure, vulnerability and risk assessment, and their implementation within the OpenQuake Engine under a number of different use cases. The course will include both theoretical lectures and training sessions on how to use the OpenQuake Engine, from basic scenario analysis to advanced modelling of probabilistic seismic hazard and risk.

INSTRUCTORS

Marco Baiguera, Exposure Analyst, GEM Foundation
Kirsty Bayliss, Seismic Hazard Modeller, GEM Foundation
Christopher Brooks, Seismic Hazard Modeller, GEM Foundation
Alejandro Calderón, Exposure Research Lead, GEM Foundation
Martina Caruso, Seismic Risk Modeller, GEM Foundation
Al Mouayed Bellah Nafeh, Physical Vulnerability Lead, GEM Foundation
Marco Pagani, Head of Seismic Hazards, GEM Foundation
Anirudh Rao, Seismic Risk Modelling Lead, GEM Foundation
Manuela Villani, Senior Seismic Hazard Modeller, GEM Foundation
Catalina Yepes Estrada, Exposure Development Lead, GEM Foundation

LECTURES/TUTORIALS

5th – 16th May 2025 (7 lectures + 6 tutorials, 30 hours)

In presence at EUCENTRE Foundation, Pavia, Italy

External students interested in attending the course should contact us via email (info@globalquakemodel.org).

Syllabus

Seismic Hazard Component - 15 hours (Week 1)

- Module 1: Components of a hazard input model: description and examples
    - Earthquake sources

    - Ground-motion models
    - Logic trees
- Module 2: Seismic Hazard Assessment
    - Classical PSHA
    - Event-based PSHA
    - Scenario-based Hazard Analysis
    - Seismic Hazard Analysis with the OpenQuake Engine
- Module 3: Advanced Seismic Hazard Analysis
    - Disaggregation
    - Conditional spectra
    - Vector-valued PSHA
    - Cross-correlated ground-motion fields and conditioning using seismic stations
    - Advanced Seismic Hazard Analysis with the OpenQuake Engine

Seismic Risk Component - 15 hours (Week 2)

- Module 4: Exposure Modelling
    - Exposure modelling at urban, regional and national scale
    - GEM Building Taxonomy
    - GEM Global Exposure Model
    - Exposure model inputs for the OpenQuake Engine
- Module 5: Vulnerability Modelling
    - Concepts of fragility and vulnerability modelling
    - GEM Vulnerability modelling framework
    - GEM Global Vulnerability database
    - Vulnerability model inputs for the OpenQuake Engine
- Module 6: Scenario Risk Modelling
    - Concepts of earthquake scenario modelling
    - Accounting for soil conditions
    - OpenQuake Engine scenario calculators
    - Exercises with scenario modelling
- Module 7: Probabilistic Seismic Risk Assessment
    - Concepts of Probabilistic Seismic Risk Assessment (PSRA)
    - GEM's Global Seismic Risk Model
    - OpenQuake Engine risk calculators
    - Exercises on event-based seismic risk modelling
    - Advanced analysis with the OpenQuake Engine