

Geophysics 4423B/9508B: Engineering Seismology

Offered winter term 2017/2018

Available as “Applied Seismology”, Earth Sciences 4423B, for 4th year Earth Science students. Also Available for graduate students in geophysics or civil engineering as Geophysics 9508B.

Short Description: This is a project-based course in which each student will develop a seismic hazard analysis for a site in North America (students will choose their site); the focus is on individual learning at a practical level in the subjects of seismicity, tectonics, strong-ground motion, seismic hazard analysis and time history selection and scaling.

- 2 lecture hours, 3 lab/tutorial hours 0.5 course
- Prerequisites: Earth Sciences 2220a/b, 2222a/b or the former 3322a/b; Calculus 2251 a/b or Calculus 2281 a/b, or permission of the Instructor. Note: Unless you have either the prerequisites for this course or written permission from the Instructor to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

Instructor: Gail Atkinson, Professor of Earth Sciences, gatkings6@uwo.ca, 661-4207

Long Description of content (Course Syllabus):

Week 1 - Overview of Engineering Seismology (Jan. 8):

- Course structure and evaluation
- Course Overview
- Some Seismic hazard and ground-motion basics

Week 2 – Seismotectonics (Jan. 15)

- Seismicity patterns and tectonic settings
- Seismic source zones in Canada
- Seismic hazard zoning for hazard analysis
- Fault versus Areal source zones

Week 3 -Earthquake Recurrence Statistics (Jan. 22)

- Earthquake magnitude and magnitude scales
- Gutenberg Richter relation
- Maximum magnitude
- Characteristic earthquake models

Week 4 – Use of EQHAZ1 to generate seismicity catalogue (Jan 29)

- EQHAZ1 theory and use
- Project-based application of EQHAZ1 to generate regional catalogue

Week 5 – Ground Motion Prediction Equations (Feb. 5)

- Ground Motion Databases
- Database issues and limitations
- Regression analysis techniques
- Role of aleatory variability (scatter)
- Overview of NGA project

Week 6 – EQHAZ2 (Feb. 12)

- Computation of mean-hazard curves using EQHAZ2

- Quiz (~Feb. 14)

Reading week (Feb. 19)

Week 7 – Extreme Ground Motions and Deaggregations (Feb. 26)

- Using EQHAZ3 to investigate extreme ground motions
- Hazard deaggregation to identify dominant magnitude/distance combinations

Week 8 – Time Histories for Design Applications (March 5)

- Selecting and scaling recorded time histories for design
- Obtaining global seismographic data, strong-motion data and other information
- Spectral-matching techniques

Week 9 – Simulation of Ground Motions (March 12)

- Types of simulations
- Stochastic modeling techniques
 - Method and input parameters
 - Point-source (Brune) stochastic model
 - One-corner vs. two-corner models of source spectra
 - Finite fault stochastic model
 - Stochastic model use in ground motion relations
- Quiz (~March 14)

Week 10 – EXSIM Finite-fault simulations (March 19)

- Use of EXSIM to simulate ground motion time histories

Week 11 – Induced Seismicity (March 26)

- Induced seismicity
- Hazard implications of induced seismicity

Week 12, 13 – Final Report Summary Presentations. (April 2 to April 11 as needed)

Course Evaluation:

Assignment 1 – Seismicity and Tectonics **20 points**

Assignment 2 – Simulated Project Seismicity Catalogue **10 points**

Assignment 3 – GMPEs and Mean-hazard curves **20 points**

Assignment 4 – Time histories to represent UHS **20 points**

Assignment 5 – Final Report **10 points**

Reading Group (ES9508 only) **20 points**

Quizzes - **20 points**

Note: Students in Engineering Seismology 9508 will have additional expectations for each assignment, in comparison to those in Applied Seismology 4423.

Due Dates: Due dates for assignments, and quiz dates, are as given below. All assignments and quizzes must be performed, or a grade of 0 for that assignment or quiz

will be given. Extensions to deadlines, or alternative quiz dates, will be provided for medical or religious reasons. The instructor will also provide reasonable accommodation for other valid reasons (such as academic conflicts) if requests are made to the Instructor at least one week in advance of the deadline.

Assignment 1 –Jan. 29

Assignment 2 – Feb. 5

Assignment 3 – March 5

Assignment 4 – March 26

Assignment 5 – April 13

Reading Group materials – Jan. 15, Jan. 29, March 5, March 19

Quiz 1 – ~Feb. 14

Quiz 2 – ~March 14

Course Materials: There are no required text books or materials. Required reading material will be available online.

Electronic Devices: Electronic calculators will be permitted during quizzes. No laptop computers or wireless communication devices will be permitted during quizzes.

Student's responsibilities in the event of a medical issue:

If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to the Dean's office as soon as possible and contact your instructor immediately. It is the student's responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor has been informed. In the event of a missed final exam, a "Recommendation of Special Examination" form must be obtained from the Dean's Office immediately. For further information please see: <http://www.uwo.ca/univsec/handbook/appeals/medical.pdf>

A student requiring academic accommodation due to illness, should use the Student Medical Certificate when visiting an off-campus medical facility or request a Records Release Form (located in the Dean's Office) for visits to Student Health Services. The form can be found here: https://studentservices.uwo.ca/secure/medical_document.pdf

Statement on Academic Offenses: Academic offenses are taken seriously. Students are directed to read the appropriate policy on academic offenses at: www.uwo.ca/univsec/handbook/appeals/scholoff.pdf

Students must write their essays and assignments in their own words. Proper referencing or quotations must be used when taking an idea or passage from another author.

Accessibility Statement

Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x.82147 for any specific question regarding an accommodation.

ES4423/GP9508 Applied Seismology

Learning Outcomes:

Upon successful completion of this course students will be able to:

- * Define an appropriate source model to express the seismicity surrounding a site of interest;
- * Characterize the rate of earthquakes in each source zone as a function of magnitude;
- * Explain and select functional representations of ground motions in a region;
- * Apply knowledge of seismicity and ground motions to define the inputs to a probabilistic seismic hazard analysis (PSHA) for a selected site;
- * Use PSHA software (EQHaz suite) to calculate the hazard for a selected site;
- * Describe the uncertainties in a PSHA and their practical impacts;
- * Interpret PSHA results to explain the significance of the hazard for a site;
- * Develop writing and presentation skills to present engineering seismology results to a broader audience.