

## **Geophysics 4423B/9508B: Engineering Seismology**

Offered winter term 2014

Available as “Applied Seismology”, Earth Sciences 4423B, for 4<sup>th</sup> 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
- Lectures Tues, Thurs. 10:30-11:30
- Lab (Tues. 2:30-5:30)
- 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](mailto:gatkings6@uwo.ca), 661-4207

### **Long Description of content (Course Syllabus):**

#### **Week 1 - Overview of Engineering Seismology (Jan. 6)**

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

#### **Week 2 – Seismotectonics (Jan. 13)**

- 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. 20)**

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

#### **Week 4 – Use of EQHAZ1 to generate seismicity catalogue (Jan 27)**

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

#### **Week 5 – Ground Motion Prediction Equations (Feb. 3)**

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

**Week 6 – EQHAZ2 (Feb. 10)**

- Computation of mean-hazard curves using EQHAZ2
- Quiz (Feb. 13)

**Reading week (Feb. 17)**

**Week 7 – Extreme Ground Motions and Deaggregations (Feb. 24)**

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

**Week 8 – Time Histories for Design Applications (March 3)**

- 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 10)**

- 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 13)

**Week 10 – EXSIM Finite-fault simulations (March 17)**

- Use of EXSIM to simulate ground motion time histories

**Week 11 – Induced Seismicity (March 24)**

- Induced seismicity
- Hazard implications of induced seismicity

**Week 12 – Final Report Summary Presentations. (March 30)**

**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 questions and expectations in each assignment and project, 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. 23

Assignment 2 – Jan. 30

Assignment 3 – Feb. 27

Assignment 4 – March 27

Assignment 5 – April 8

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

Quiz 1 – Feb. 13

Quiz 2 – March 13

**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](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](http://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.