



UNIVERSITY OF CALGARY

DEPARTMENT OF GEOSCIENCE COURSE OUTLINE

1. Course: GOPH 667, Introduction to Microseismic Methods

Lecture Sections: B01

L01: September 02 2014 – September 06 2014, 08:00-16:00, University of Calgary Downtown Campus (906-8th Ave SW, Calgary, AB)

Dr. D. Eaton, Office: ES 214, Ph. 403-220-4233, eatond@ucalgary.ca, Office Hours: Thursdays 9-11 am

Desire 2 Learn (D2L) course name: F2014GOPH667L01

Geoscience Department ES 118, 403-220-5841, geoscience.ucalgary.ca, geosci@ucalgary.ca

2. Prerequisites: Students should be enrolled in the graduate program in geophysics or receive the consent of the Department. See also Geophysics [Course Descriptions](#) of the University Calendar.

3. Grading: The University policy on grading and related matters is described sections [F.1](#) and [F.2](#) of the online University Calendar. In determining the overall grade in the course the following weights will be used:

There will be a ~20-page written course project that will be graded on a letter grade scale. This report will be a literature review on a topic proposed by the student and agreed to by the instructor no later than September 6, 2014. This is the only graded component of the course. The deadline for submission of the report is October 17, 2014 (4pm).

4. Missed Components of Term Work: The regulations of the Faculty of Science pertaining to this matter are found in the Faculty of Science area of the Calendar in [Section 3.6](#). It is the student's responsibility to familiarize himself/herself with these regulations. See also [Section E.6](#) of the University Calendar

5. Course Materials:

Course notes will be provided at the start of the course.

6. Approved Mandatory Course Supplemental Fees: In order to cover costs of reproduction including material reproduced with Copyright permission, the cost of course notes will be \$25.

7. Writing across the curriculum statement: In this course, the quality of the student's writing will be a factor in the evaluation of the final course project report. See also [Section E.2](#) of the University Calendar.

8. OTHER IMPORTANT INFORMATION FOR STUDENTS:

(a) Academic Misconduct: (cheating, plagiarism, or any other form) is a very serious offence that will be dealt with rigorously in all cases. A single offence may lead to disciplinary probation or suspension or expulsion. The Faculty of Science follows a zero tolerance policy regarding dishonesty. Please read the sections of the University Calendar under [Section K](#). Student Misconduct to inform yourself of definitions, processes and penalties

(b) Assembly Points: In case of emergency during class time, be sure to FAMILIARIZE YOURSELF with the information on [assembly points](#).

(c) Academic Accommodation Policy: Students with documentable disabilities are referred to the following links: [Calendar entry on students with disabilities](#) and [Student Accessibility Services](#).

(d) Safewalk: Campus Security will escort individuals day or night (<http://www.ucalgary.ca/security/safewalk/>). Call 220-5333 for assistance. Use any campus phone, emergency phone or the yellow phones located at most parking lot pay booths.

- (e) Freedom of Information and Privacy:** This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIPP). As one consequence, students should identify themselves on all written work by placing their name on the front page and their ID number on each subsequent page. For more information see also <http://www.ucalgary.ca/secretariat/privacy>.
- (f) Student Union Information:** VP Academic Phone: 220-3911 Email: suvpaca@ucalgary.ca.
SU Faculty Rep. Phone: 220-3913 Email: sciencerep@su.ucalgary.ca; [Student Ombudsman](#)
- (g) Internet and Electronic Device Information:** You can assume that in all classes that you attend, your cell phone should be turned off unless instructed otherwise. Also, communication with other individuals, via laptop computers, Blackberries or other devices connectable to the Internet is not allowed in class time unless specifically permitted by the instructor. If you violate this policy you may be asked to leave the classroom. Repeated abuse may result in a charge of misconduct.
- (h)** At the University of Calgary, feedback provided by students through the Universal Student Ratings of Instruction (USRI) survey provides valuable information to help with evaluating instruction, enhancing learning and teaching, and selecting courses (www.ucalgary.ca/usri). Your responses make a difference - please participate in USRI Surveys.

TENTATIVE SCHEDULE AND ADDITIONAL COURSE INFORMATION

This will be a 5-day course, with morning lectures and afternoon computer exercises.

Topics for each day:

Day 1. Fundamentals of passive seismology

- P and S waves in elastic media
- Attenuation and anisotropy
- Full waveform modeling methods
- Seismic sources including moment tensors
- Spectral characteristics of seismic sources
- Magnitude and moment
- Statistical seismology
- Sensor basics

Day 2. Geomechanics and Data Acquisition

- Stress and strain
- Mohr diagram
- Coulomb stress field
- Modes of rock failure
- Pore-pressure diffusion
- Hydraulic fracture treatment
- Microseismic data acquisition
- Continuous microseismic monitoring

Day 3. Microseismic data processing I

- Review of signal processing
- Anatomy of a microseismic event
- Event detection algorithms
- Velocity model construction
- Microseismic catalogs
- Hypocentre location
- Polarization analysis

Day 4. Microseismic data processing II

- Imaging methods using surface microseismic data
- Real-time processing
- Methods for calculating traveltimes (ray tracing, ray bending, eikonal)
- Uncertainty analysis
- Multiplet analysis and double-difference location algorithms
- Ambient-noise recording

Day 5. Microseismic interpretation

- Event classification
- Moment-tensor inversion
- Estimated stimulated reservoir volume
- Spectral analysis
- Spatio-temporal analysis
- Anisotropy and shear-wave splitting

Some sections will be taught by invited presenters.