

EESC26 Seismology and Seismic Methods

Professor Phil Heron

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Office: EV344 (UTSC)

Lecture 1: Tuesday (1-2pm) EV140

Lecture 2: Thursday (1-3pm) EV502

Course description: A course describing how seismology is used to probe both shallow layers near the surface as well as Earth's deep interior. Topics covered will include refraction and reflection methods, surface waves, tomography, magnitude and the Richter scale. Concepts including travel times and anisotropy will be discussed.

Learning outcomes:

Students should leave this course with:

1. an understanding of different seismic topics covered (see below);
2. experience in using computational software related to seismology;
3. analyze and interpret different forms of seismic data, focussing on reflection and tomography data;
4. communicate seismic data and related interpretations to specialist and general audiences.

Topics covered:

The topics covered will link the use of Seismology to technical theory, applied theory, and future advances, including:

- stress and strain
- wave equation
- data inversion
- tomography imaging
- anisotropy
- reflection surveys
- refraction surveys
- data analysis and data science
- Body waves and surface waves
- Earthquake magnitude and frequency
- Earthquake prediction
- Earthquake early warning systems
- Canada's Seismic Hazard Map
- Martian seismology
- Science communication.

Key dates for Winter 2023:

Classes Begin	Monday, Jan 09, 2023
Drop Date	Monday, Mar 27, 2023

Last Day of Classes	Monday, Apr 10, 2023
Final Assessment Period	Thursday, Apr 13, 2023 - Thursday, Apr 27, 2023
First Term, Reading Week	Saturday, Feb 18 2023 - Friday, Feb 24 2023
Family Day	Monday, Feb 20 2023
Easter	Friday, Apr 07 2023

Lectures:

Lectures will be in person throughout the term, split into one hour on a Tuesday and 2 hours on a Thursday. From week 11 onwards classes will take the form of tutorials/office hours for students to work on their final projects. Lecture slides will be available online before the class starts and for the exclusive use of enrolled students. Public sharing of the material is not permitted.

Office hours:

Office hours will be available by appointment.

Grading, purpose, timing, and submission guidelines for assignments:

Assignment	Purpose	Assessment	Where	%	Date given	Due date	Time
BR: Background reading	Clear on course objectives	Multiple-choice questions	Online, quercus	5%	12/1	19/1	7 days
A1: Stress and strain problem set	Understanding of seismic wave equation, stress and strain, and computational seismology	Problem set on data given	Online, quercus	15%	19/1	30/1	11 days
A2: Travel time problem set	Understanding travel times and computational seismology	Problem set on data given	Online, quercus	5%	2/2	9/2	7 days
A3: Tomography assignment	Understanding images from within the Earth, and its uncertainty	Report	Online, quercus	30%	9/2	27/2	18 days
A4: Reflection assignment	Understanding seismic reflection data and computational seismology	Problem set on data given	Online, quercus	20%	2/3	20/3	18 days

Mini: Participation in mini conference	Science communication training	In class	In class	5%	23/3	23/3	In class
A5: Oral presentation on chosen topic	Description of new research on seismology	15-minute oral presentation	In class	20%	21/3	6/4	16 days

(Specific grading will be given on each assignment)

Late penalty:

Late assignments will be penalised by 10% a day.

Methods of assessment:

Methods of assessment will be split between problem sets, reports, presentations, and a multiple-choice quiz:

- A multiple-choice online quiz will be provided to capture the students' understanding of the objectives and expectations for the course (**BR**). This is essentially a contract between student and instructor on best practices for the coursework.
- Three problem sets on geophysical data interpretation (**A1/A2/A4**). The work here will show the student's understanding of seismic theory data based on specific lessons.
- A written report on seismic tomography (**A3**) will show an understanding of the various factors required in imaging the Earth's interior.
- There will be a mini conference (**Mini**) where students will discuss various science communication techniques to be applied to their final presentation. The grading will be on participation in this mini academic conference.
- An oral presentation of 2-3 recent scientific advances (**A5**) will allow students to show an understanding of a given seismic topic (see above), as well as apply the science communication skills discussed in the mini conference.

Spread of grades throughout the course:

Week	BR	A1	A2	A3	A4	Mini	A5
1	5%						
2		15%					
3		15%					
4			5%				
5				30%			
6				30%			
7				30%			
8					20%		
9					20%		
10					20%		

11						5%	20%
12							20%
13							20%

Week by week Syllabus (and grouped themes of technical, application, and future work):

Week	W/c	Tue (1-2pm)	Thurs (1-2pm)	Assignment
1	9/1	L01: Introduction	L02: Stress and Strain	BR
2	16/1	L03: Wave equation I	L03: Wave equation II	A1
3	23/1	L04: Travel time I	L04: Travel time II	A1
4	30/1	L05: Data Inversion I	L06: Data Inversion II	A2
5	6/2	L07: Tomography I	L07: Tomography II	A3
6	13/2	L08: Anisotropy	L09: Reflection seismology I	A3
7	20/2	Reading week	Reading Week	A3
8	27/2	L09: Reflection seismology II	L10: Surface waves	A4
9	6/3	L11: Earthquake source analysis	L12: Earthquake prediction	A4
10	13/3	L13: Early warning systems	L14: Martian seismology	
11	20/3	A5 outline	Mini conference	Mini
12	27/3	A5 Tutorials	A5 Tutorials	A5
13	3/4	A5 Tutorials	Presentation day	A5

Academic Integrity

The University treats cases of cheating and plagiarism very seriously. The University of Toronto's Code of Behaviour on Academic Matters (<http://www.governingcouncil.utoronto.ca/policies/behaveac.htm>) outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences.

Potential offences in papers and assignments include using someone else's ideas or words without appropriate acknowledgement, submitting your own work in more than one course without the permission of the instructor, making up sources or facts, obtaining or providing unauthorized assistance on any assignment.

On tests and exams cheating includes using or possessing unauthorized aids, looking at someone else's answers during an exam or test, misrepresenting your identity, or falsifying or altering any documentation required by the University, including (but not limited to) doctor's notes.

Quercus info:

This course uses the University's learning management system, Quercus, to post information about the course. This includes posting readings and other materials required to complete class activities and course assignments, as well as sharing important announcements and updates. The site is dynamic and new information and resources will be posted regularly as we move through the term, so please make it a habit to log in to the site on a regular, even daily, basis. To access the course website, go to the U of T Quercus log-in page at <https://q.utoronto.ca>. Once you have logged in to Quercus using your UTORid and password, you should see the link or "card" for [EESC26H3 S]. You may need to scroll through other cards to find this. Click on the [EESC26H3 S] link to open our course area, view the latest announcements and access your course resources. There are Quercus help guides for students that you can access by clicking on the "?" icon in the left side column.

Please also note that any grades posted are for your information only, so you can view and track your progress through the course. No grades are considered official, including any posted in Quercus at any point in the term, until they have been formally approved and posted on ACORN at the end of the course. Please contact me as soon as possible if you think there is an error in any grade posted on Quercus.

Religious Accommodations

The University has a commitment concerning accommodation for religious observances. I will make every reasonable effort to avoid scheduling tests, examinations, or other compulsory activities on religious holy days not captured by statutory holidays. According to University Policy, if you anticipate being absent from class or missing a major course activity (like a test, or in-class assignment) due to a religious observance, please let me know as early in the course as possible, and with sufficient notice (at least two to three weeks), so that we can work together to make alternate arrangements.

Specific Medical Circumstances

If you become ill and it affects your ability to do your academic work, consult the course instructor right away. Normally, you will be asked for medical documentation in support of your specific medical circumstances. The University's Verification of Student Illness or Injury (VOI) form is recommended because it indicates the impact and severity of the illness, while protecting your privacy about the details of the nature of the illness. You can submit a different form (like a letter from the doctor), as long as it is an original document, and it contains the same information as the VOI. For more information, please see <http://www.illnessverification.utoronto.ca/> If you get a concussion, break your hand, or suffer some other acute injury, you should register with Accessibility Services (AS) as soon as possible. A student registered with the AS isn't usually asked to provide a VOI because registration with AS already requires students to provide health-related documentation.

Accommodation for Personal Reasons

There may be times when you are unable to complete course work on time due to non-medical reasons. If you have concerns, speak to me. It is also a very good idea to speak with an academic advisor.

Participation and engagement

Please stay on task if you choose to use laptops or other mobile devices during class. These tools can be useful to take notes, refer to class readings, or look up important course concepts. However, checking social media, texting or other non-course specific activity distracts from your learning and can ultimately result in receiving a lower grade in this course.

Recording or photographing any aspect of a university course - lecture, tutorial, seminar, lab, studio, practice session, field trip etc. – without prior approval of all involved and with written approval from the instructor is not permitted. For further information on University policies, please refer to the following links for details.

The university has a responsibility to provide academic accommodations, including the use of technology to access the lecture in a way that will be accessible to them (e.g. recording lectures, using laptops, etc).

Equity, Diversity and Inclusion

The University of Toronto is committed to equity, human rights and respect for diversity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect where all members of our community can express themselves, engage with each other, and respect one another's differences. U of T does not condone discrimination or harassment against any persons or communities.

Contact

For any questions, large or small, please do not hesitate to email me: Philip.heeron@utoronto.ca