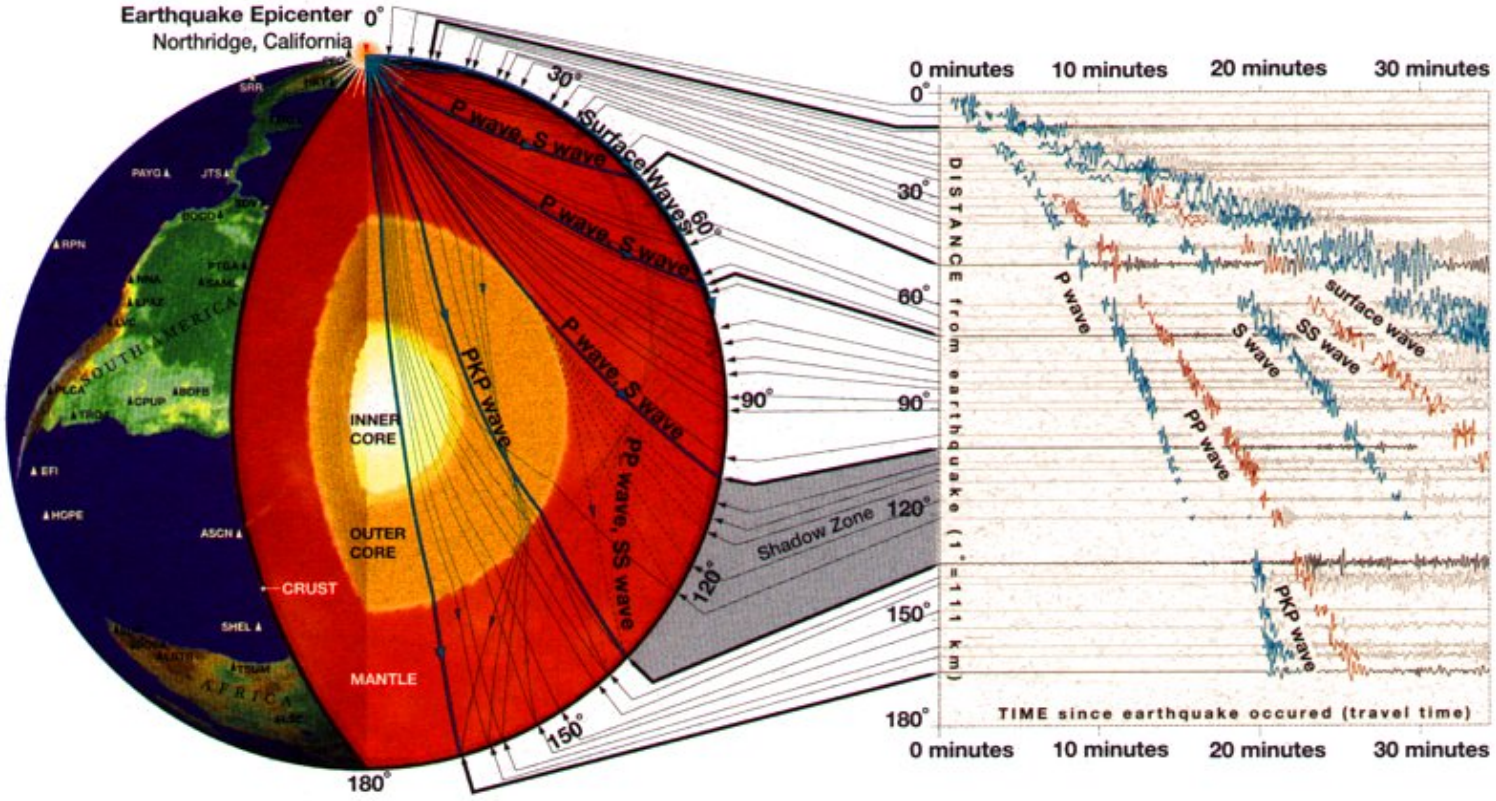
# EOS/PHYS 210
# Introductory Geophysics
## September–December, 2022




Example of geophysical remote sensing: Earthquake-generated seismic waves penetrate the earth and return to the surface, providing information on interior structure of inner core, outer core, mantle, and crust (IRIS Educational and Public Outreach Program, NSF EAR-1261681).

**Territorial Acknowledgement:** *We acknowledge with respect the Lekwungen peoples on whose traditional territory the University of Victoria stands, and the Songhees, Esquimalt and W̱SÁNEĆ peoples whose historical relationships with the land continue to this day.*

**COURSE OUTLINE**

**University of Victoria**
**School of Earth and Ocean Sciences**
**Department of Physics and Astronomy**

# EOS/PHYS 210
# Introductory Geophysics

**Fall 2022 (Term 202209, A01)**

**Class Schedule:**
Lectures: Tuesdays, Wednesdays, Fridays, 9:30–10:20, Elliott 062
Tutorials: 2:30–4:20, Wednesdays, as per schedule developed in class, online (zoom)

**Instructor:**
Stan Dosso, Bob Wright Centre A331; `sdosso@uvic.ca`
Please include "EOS 210" or "PHYS 210" in the subject line of any email.

**Office Hours:**
1:30–3:00 Thursdays, or make an appointment by email. Office hours can be in-person or virtual via the course zoom site (to be provided), but in-person visits will be prioritized.

**Teaching Assistant (TA):**
Madison Bombardier, `mlbombardier@uvic.ca`

**Course Description:**
Introduction to seismology, gravity, geomagnetism, paleomagnetism and heat flow, and how they contribute to our understanding of whole earth structure and plate tectonics.

**Prerequisites:**
PHYS 110 or 120; MATH 101.

**Text (Optional):**
R. J. Lillie, 1999, *Whole Earth Geophysics: An Introductory Textbook for Geologists and Geophysicists*, Prentice Hall, Toronto. Selected topics from Chapters 1–10.

**Course Website:**
Course materials will be available on the UVic Brightspace system. Course notes will be developed in class. Notes will also be posted at the end of each week as an additional resource. *Please attend classes and take notes!*

**Tutorials:**

Tutorials will provide an introduction to the fundamentals of computer coding based on MATLAB, as required for some assignments. Tutorial notes will be posted in advance—please read beforehand. Tutorials will be at a beginner (elementary) level and are optional: students with a background in coding may not find them necessary. Tutorials will be held online (zoom), with the schedule developed during the course (we may not need a tutorial every week). Tutorials begin Sept. 14. Before this date, all students should install MATLAB on their computer (free) by visiting `https://www.mathworks.com/academia/tah-portal/university-of-victoria-31110150.html`, clicking the "sign in to get started" button, and following the directions.

**COVID-19 Policy:**

UVic continues to follow all public health orders and the health and safety measures required by the Provincial Health Officer, including the public health guidance developed specifically for post-secondary institutions by the BC Centre for Disease Control. We continue to monitor and prepare for any changes that may occur as a result of COVID-19. Please visit the COVID-19 website for more details and to learn about any updates on UVic's response to COVID-19: `https://www.uvic.ca/covid19/`. The following summarizes UVic's current policies:

- Masks: We encourage you to wear a mask in indoor public spaces, particularly if you are close to others or feel more comfortable doing so. Masks are required in some healthcare settings, such as the Student Wellness Centre.
- Vaccination: Vaccination remains the most effective means of protection against COVID-19. We encourage you to get your booster dose when you are eligible. In BC, booster doses are being offered to everyone 12+ in the fall.
- Daily health assessment: Do a daily health assessment. If you're sick, stay home and follow public health guidelines.
- Rapid tests: Free rapid test kits are available at the UVic Bookstore and Campus Security Services for students, faculty and staff.

**Grading:**

| | |
|---|---|
| Weekly Assignments | — 30 % |
| Midterm Exam 1 (Oct. 11) | — 20 % |
| Midterm Exam 2 (Nov. 15) | — 20 % |
| Final Exam (within Dec. 7–21) | — 30 % |

- Assignments must be submitted as a PDF file to Brightspace (photos of handwritten work converted to PDF are acceptable, provided they are fully legible). Assignments are due at the start of Friday classes, as assigned.
- Practice exams will be provided prior to exams as a study aid. Mathematical formulas needed for exams will be provided on the exam—no need to memorize or prepare your own formula sheet.
- If you miss or know you will miss a midterm or final exam, let me know as soon as possible. For justified reasons (e.g., illness) the value of a missed midterm will be added

to the cumulative final exam. If two midterms are missed, a make-up exam must be scheduled. If the final exam is missed, a make-up exam must be scheduled.

- Useful dates: Sept. 20 is the last day to drop a course with full refund. Sept. 23 is the last day for adding a course. Oct. 31 is the last day for course withdrawal without penalty of failure. The final exam period is Dec. 7–21; you must be available for an in-person exam during this time.
- Any instances of cheating or plagiarism will be acted upon. Students are advised to refer to the UVic policy on Academic Integrity found at `web.uvic.ca/calendar/FACS/UnIn/UARe/PoAcI.html`

**UVic Grade Equivalences:**

| Percentage | Letter Grade | Num. Grade | Standing |
|---|---|---|---|
| 90–100 | A+ | 9 | |
| 85–89 | A | 8 | 1st Class |
| 80–84 | A− | 7 | |
| 77–79 | B+ | 6 | |
| 73–76 | B | 5 | 2nd Class |
| 70–72 | B− | 4 | |
| 65–69 | C+ | 3 | |
| 60–64 | C | 2 | Pass |
| 50–59 | D | 1 | |
| $< 50$ | F | 0 | Fail |

# Course Outline:

The following is an approximate outline for EOS/PHYS 210. The (optional) text can provide a useful reference for most of the material; however, assignments and exams are based on the course notes and tutorials. Note also that several topics will be covered that are not in the text, and a number of topics in the text will not be included in the course.

1. **Introduction** (Text pages 14–44; Approximately 3 classes)
    - What is geophysics?
    - Basic geophysical approaches, forward and inverse problems
    - Basic earth structure (crust/mantle/core; lithosphere/asthenosphere)
    - Basic plate tectonics (plate types, margins and movements; tectonic cycle)
    - Juan de Fuca plate system
2. **Seismic Waves in the Earth** (Text pages 45–59; Approximately 6 classes)
    - Elastic properties of solids (stress and strain, Hooke's law, bulk modulus, shear modulus, Young's modulus, Poisson's ratio)
    - Body waves (compressional and shear waves)
    - Surface waves (Rayleigh and Love waves; wave dispersion)
    - Wave propagation losses (geometric spreading, absorption)
    - Waves at boundaries: reflection, refraction, conversion; Snell's law
3. **Seismic Refraction** (Text pages 59–96; Approximately 4 classes)
    - Critical refraction
    - Slope-intercept inversion method (single and multiple layers)
    - Low-velocity zones
    - Crustal structure and thickness
4. **Seismic Reflection** (Text pages 100-111; Approximately 4 classes)
    - Reflection time-distance curves
    - Dix inversion (single and multiple layers)
    - Imaging the subsurface: Seismic data processing (velocity analysis, normal moveout, stacking, migration)
    - Seismic images of geologic/tectonic features

5. **Earthquake Seismology** (Text pages 185–205; Approximately 6 classes)

    - Earthquake mechanisms and locations (normal/reverse/strike-slip faults; earthquakes at tectonic margins)
    - Locating earthquakes (uniform-velocity method; time-distance curves)
    - Earthquake intensity and magnitude scales (Mercalli intensity; Richter magnitude, surface-wave magnitude, body-wave magnitude, moment magnitude)
    - Earthquake seismograms and Earth structure

6. **Gravity and Isostasy** (Text chapter 8; Approximately 6 classes)

    - Gravity on the earth's surface
    - Measuring gravity
    - Gravity corrections and anomalies (latitude adjustment, elevation adjustment, excess mass adjustment, Bouguer gravity anomaly)
    - Isostasy
    - Gravity and geologic/tectonic features

7. **Heat Flow** (Text chapter 10; Approximately 4 classes)

    - Heat sources within the earth
    - Heat transfer (conduction, convection, radiation)
    - Heat-flow equation
    - Heat flow measurements
    - Radial temperature variation
    - Oceanic heat flow and evolution of oceanic crust
    - Heat as a driving force for plate tectonics

8. **Magnetic Methods** (Text chapter 9; Approximately 4 classes)

    - Source of magnetic field (geodynamo, Faraday disc)
    - Earth's magnetic field (axial dipole model)
    - Magnetic induction and susceptibility
    - Magnetization and magnetic anomalies
    - Paleomagnetism (geomagnetic polarity time scale)
    - Oceanic magnetic anomalies and plate kinematics