

ERTH2105 – Geodynamics

Geodynamics refers to the processes by which mantle convection shapes and reshapes the Earth. It applies physics, chemistry and mathematics to the understanding of the theory of Plate Tectonics. The goal is to give you the tools you need to understand the conceptual underpinnings of plate tectonics, including the kinematics and dynamics of plate motions. We will touch on topics drawn from seismology, gravity and geomagnetism, solid mechanics, and heat flow, among others. This course will also cover the Earth's deeper interior, considering the fundamental processes of Earth's interior deformation and touching on interactions between the interior and the plates through geologic time. In short: the structure, composition, and rheological properties of the Earth: lithosphere, mantle and core.

Some grand challenges that geoscientists have and continue to tackle are the movement of the continents, mantle convection's diverse expressions represented by subduction zones, spreading centers, plumes etc., and the brittle lithosphere and its relationship between faulting and earthquakes. As we will learn in this course, the major paradigms shaping the solid Earth Sciences over the past decades are essentially geodynamic concepts. Thus, the goal is to have a solid knowledge of plate tectonics and its relation to geophysical fields, driving mechanisms, and processes at plate boundaries and in plate interiors.

Prerequisites: EARTH 1006 or permission of the Department.

Lectures two hours a week and a laboratory three hours a week

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Office hours: Wednesday 1:00 - 3:00 pm, or by appointment

Teaching Assistants:

TBD

Office hours: TBD

TBD

Office Hours: TBD

Course Text: Fowler, C.M.R., 2005. The Solid Earth, 2nd edn. Cambridge Univ. Press.

Note: Books were ordered at the book store and are on reserve at the library. You may also buy used ones from Haven Books, 43 Seneca St, Ottawa (613) 730-9888.

Course Topics (Tentative order):

- Seismology and the internal structure of the Earth
- Gravity and isostasy
- lithosphere flexure and post glacial rebound
- Plate tectonics: geometry and kinematics
- Geomagnetic field and palaeomagnetism
- Heat flow and thermal parameters
- Temperature in the Earth's interior

- Sea-floor spreading and oceanic lithosphere
- The continental lithosphere

Learning Objectives

- Develop a firm understanding of the basics of seismology
- Utilize earthquake seismology to investigate the Earth’s interior
- Develop a physical intuition for the tectonic and convective processes that shape our planet
- Understand Earth’s physical properties and its existing potential fields
- Analyze the regional variations of Earth’s gravitational field to explain isostasy, lithosphere flexure and post glacial rebound
- Relate the Earth’s magnetic field to the internal structure of the Earth
- Determine the structure and properties of the lithosphere
- Explain the heat model for the internal structure of the Earth
- analyze current and present kinematics of tectonic plates using palaeomagnetism and sea-floor spreading

Grading Scheme

Laboratory attendance and assignments	30%
Exam 1 (Oct. 11?)	30%
Exam 2	40%

The laboratory assignments will be a combination of theoretical practice problems and more practical applications solved on the computer. They should be completed within the scheduled laboratory time, but if extra time is needed then they will be due by the start of the following lab period. I encourage you to discuss the problems with your classmates, but it is absolutely imperative that any work you submit is your own. This means you must very clearly attribute any quotations or copied figures (citing name + year + publication of any sources). You should always mention any classmates with whom you have collaborated (a brief marginal note will suffice), and it is not EVER permitted to copy another student’s work. If you are found to be in violation of this policy, there are very serious consequences. The instructor *is required* to report all incidents (or suspected incidents) of plagiarism to the Dean.

Exam 1 will be an in-class exam and will consist of long answer questions. Exam 2 will be in the formally scheduled exam time and will also be long answer.

For all labs and exams *always* show your full working for mathematical problems. As well as making it much easier to judge where/if you made any errors, I will not award full marks if the logic and work-flow of the answer is not clear. Make sure to properly highlight your final answer to each problem. Answers should be mathematically *correct*, i.e. if you write an “equals sign”, both things on either side of it must be equal. This sounds totally obvious, but it is often not done, leading to avoidable errors and marks deducted. **Get in the practice of being meticulous with your mathematics!**

COURSE REQUIREMENTS:

- Attendance for laboratories is mandatory.
- The lab component of the course must be passed in order to pass the course. You must pass the lab component of the course in order to write the final exam.
- The final exam must be passed in order to pass the course.
- Labs must be handed in on time. Late labs will be accepted in the instance of illness, with medical note, or in the instance of emergencies
- It is the student's responsibility to come to classes and labs prepared. Reading assignments are mandatory
- Regularly log onto the CU Learn course website to check for announcements, course information, laboratory assignments and lecture material.
- Lab exercises will be posted on CU Learn. Print them off and bring them to the lab period.

Tentative Schedule (note: it is subject to change):

Week	Class Date	Topic	Lab
1	Sept. 6	Seismology & internal structure of the Earth I	NO lab
2	Sept. 13	Seismology & internal structure of the Earth II	Introductory lab
3	Sept. 20	Seismology & internal structure of the Earth II	Lab 1 - Seismology
4	Sept. 27	Gravity and Isostasy	Lab 2 - Seismology
5	Oct. 4	Flexure of the lithosphere	Lab 3 - Gravity
6	Oct. 11	MIDTERM	Review
7	Oct. 18	Plate tectonics; geometry & kinematics I	Lab 3 – Gravity & Isostasy
8	Oct. 25	FALL BREAK	
9	Nov. 1	Plate tectonics; geometry & kinematics II	Lab 4 – Plate tectonics
10	Nov. 8	Heat flow and thermal parameters	Lab 5 - Paleomagnetism
11	Nov. 15	Temperature in the Earth's interior	Lab 6 - Heat
12	Nov. 22	Sea-floor spreading and oceanic lithosphere	Lab 7 – Earth's interior
13	Nov. 29	The continental lithosphere	Lab 8 – Oceanic litho.
14	Dec. 6	Review	NO lab

ACADEMIC INTEGRITY

It is your responsibility to review Carleton's policy on Academic Integrity - Section 14 of the Calendar.

<http://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/acadregsuniv14/>

Plagiarism

The instructor is required to report all incidents (or suspected incidents) of plagiarism to the Dean. **All work handed in must be your own.** Plagiarism and cheating are viewed as being particularly serious and the sanctions imposed are accordingly severe. Students are expected to familiarize themselves with and follow the Carleton University Student Academic Integrity Policy. The Policy is strictly enforced and is binding on all students. Plagiarism and cheating – presenting another’s ideas, arguments, words or images as your own, using unauthorized material, misrepresentation, fabricating or misrepresenting research data, unauthorized co-operation or collaboration or completing work for another student – weaken the quality of the graduate degree. Academic dishonesty in any form will not be tolerated. Students who infringe the Policy may be subject to one of several penalties including: expulsion; suspension from all studies at Carleton; suspension from full-time studies; a refusal of permission to continue or to register in a specific degree program; academic probation; or a grade of Failure in the course.

REQUESTS FOR ACADEMIC ACCOMMODATION

Please review the Carleton’s Student Guide to Academic Accommodations at

<http://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf>, and the websites therein.

For Students with Disabilities:

“The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your ***Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation.*** After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website (www.carleton.ca/pmc) for the deadline to request accommodations for the formally-scheduled exam . “

For Religious Observance:

1. *As soon as you receive your course syllabus*, identify any potential conflicts between your religious obligations and course requirements. **2.** Make a formal written request to your instructor indicating the nature of the religious obligation and suggest possible alternative dates and/or means of satisfying the academic requirements. *NOTE: Such request should be made during the first two weeks of the term*, or as soon as possible after a need for accommodation is known to exist, but in no case later than the second last week of classes for that term. For detailed information on Religious Obligations please visit our website at: carleton.ca/equity/accommodation/academic.

For Pregnancy:

A. For final exams. Identify and discuss your needs for final examinations with your professors. When an agreement is reached fill out and submit the online **Pregnancy Accommodation Final Exam Request Form** at: carleton.ca/equity/accommodation. Equity Services will forward the request to Exam Services to coordinate the accommodation. **B.** For in-class accommodations **ONLY**. If you anticipate you will only require in-class accommodations, discuss them directly with your course instructor. This request should be made in the first two weeks of the academic term. For detailed information on pregnancy and parental leave policies please visit the website at: carleton.ca/equity/accommodation/academic/