Class Information: SIO 103 Introduction to Geophysics

Instructors

Ross Parnell-Turner
Office: 333, IGPP Munk Lab
Email: rparnellturner@ucsd.edu

Steve Constable
Office: 326, IGPP Munk Lab
Email: sconstable@ucsd.edu

Teaching Assistant

Margaret Morris
Office: 201, IGPP Munk Lab
email: mam132@ucsd.edu

Class Meeting Times and Locations

Lectures: Tue/Th 9:00–10:20 Revelle Building Room 4301 (top floor)
Problem session: Th 10:20–11:10 Revelle Building Room 4301 (top floor)

Student hours

Ross & Steve: after lectures and problem sessions, or email for a meeting
Margaret: after problem sessions and on Fridays (time TBC), or email for a meeting
Please include 'SIO103' in the subject line of emails

Class website on Canvas

canvas.ucsd.edu/courses/10350
Here you will find class information, lecture notes, and problem sets.

Class Format

Lectures: 2 per week
Problem session: 1 per week (answers due on Tuesdays)
Essay: 2000-word review paper, due in last class (Mar 12)
Mid-term: tentatively Feb 13, 9:00–10:20 Revelle Building Room 4301)
Final: Mar 17, 8:00–11:00 Revelle Building Room 4301

Textbook

The main reading for the class are the comprehensive notes posted on the website. For additional reading see *The Solid Earth: An Introduction to Global Geophysics by C. M. R. Fowler (2004, 2nd Edition).* This textbook is not required, but we are sure there are times when a second view of the material will help. A couple of copies of the book will be available in the IGPP Munk reading room. For the some additional reading on seismology, see *Introduction to Seismology* by Peter Shearer.

Grading

Final exam: 45%
Mid-term exam: 30%
Essay: 15%
Problem sets: 10%

Mid-term and Final exams

Exam questions will broadly follow the same format as those in the problem sheets. You will be asked to answer six questions from two groups of questions, and you will be allowed to use an optional 'cheat sheet'. The cheat sheet can be of any length, should be written on single-sided paper, and can have no worked problems or derivations, no pictures, and no essays (or even complete sentences). It should just have equations on it with maybe a couple of words by each one.

Essay assignment

You will write a review essay to be submitted in the final class (March 12), with the title chosen from the list given in Week 1. You may choose your own title, but it must be approved by Ross or Steve first. Initial drafts will be accepted for comments and suggestions for improvements anytime between Feb 13 and Feb 25, and will be returned to you to aid your final draft. Essays should be fully referenced, up to 2000 words long (including figure captions, but not including title or references), and include up to four figures. They should be typed in 12-pt size font, with citations using the author-date format, and provided in pdf format. The grading rubric will be provided.

Problem sets

Problem sheets will be handed out every week and are due one week later (on Tuesdays). There is a required problem session on Thursday where we will discuss the problem sheets and any other things that crop up. Note that *you* will be doing the problems in the problem session so we recommend you make an attempt at the problem set before Wednesday.

Perhaps the hardest part of the course is learning to put a problem given in words into a mathematical form. This is a skill which is learned by practice so do the problem sheets . Once you have put the problem into mathematical form, you will be expected to solve it. If you state clearly at the outset how you are going to solve the problem, we won't be too concerned about algebraic slips made along the way. The level of mathematics that is required may seem challenging to some, but the basic tool that we shall use is elementary calculus. We will try to explain any mathematical tricks as they come along. Questions 1 and 2 on the first problem sheet are typical of the problems we end up solving. They look like nasty differential equations but actually they are separable (i.e. you can get all the y's on one side of the equation and all the x's on the other and then integrate). Don't forget constants of integration when you integrate – the boundary conditions are provided to allow you to evaluate the constants of integration. Questions 3 and 4 introduce a couple of tricks that you have probably seen before but may have forgotten about. If you find these problems impossibly difficult, you should come to see Ross.

You will likely need to spend about 8 hours each week to do a good job on each problem set. The instructors are happy to provide help if needed.

A solution sheet will be handed out on the Thursday that follows the homework due date, which means that we can not accept late problem sets.

Tips on doing problem sets

When you first see a problem set, nearly every question may seem difficult. You will eventually adjust and recognize that, for most people, this is a typical starting point. After using whatever resources you have (notes from lectures, course notes, textbooks, etc) you will get some idea of how to do the problem, but sometimes you will get stuck. Some weeks you will get stuck on several problems and this is both totally natural and expected. The key to success is to start early. The earlier you identify which problems you are getting stuck on, the more time you will have to ensure you get the problem set completed.

Note that it is often helpful to draw a picture, particularly if there is a 3D aspect to the problem. You should also write down the relevant governing equations and any other information you will need (like boundary conditions – don't worry we'll explain this). While working through the solution, do things in a general way first using symbols and wait until you have a final algebraic expression before substituting in any numerical values. Lastly, after you have worked out the solution for each problem, ask yourself, does the answer make sense? Does the answer have the order of magnitude you would have expected? Does it have the right units?

When you write out your final version, make sure to include words and explanation along with the mathematical steps. Leave enough space for the instructors to give you comments and show you where you may have made a mistake. Remember this is not a contest to see who can complete the problem set using the least amount of paper. The final write up for each problem will reinforce your understanding, and the neater presentation will be useful when you go to study for the exams.

Working in Groups

You are welcome to work in teams to figure out the solutions, but the goal is to have everyone understand the solutions at an individual level so please ensure that the teamwork doesn't do any of your peers a disservice in this way - because it will hurt them when it comes to exam time. In any case, the homeworks should be written up individually, even if it took help from the entire group to find the solution.

SIO 103: 2020 Provisional Schedule

Class, Date	Topic	Reading	
1, Jan 7	Class overview; origin of Earth and Solar System; math review	Chapter 1	Ross
2, Jan 9	Internal Constitution of Earth: the mantle	Chapter 6, Fowler-8	Steve
3, Jan 14	Internal Constitution of Earth: the core	Chapter 6, Fowler-8	Steve
4, Jan 16	Seismology introduction, linear elasticity and wave equation	Chapter 2, Fowler-4	Ross
5, Jan 21	Ray theory, travel time curves	Chapter 2, Fowler-4	Ross
6, Jan 23	Refraction and reflection seismology	Chapter 2, Fowler-4	Ross
7, Jan 28	Global body waves, ray nomenclature, normal modes	Chapter 2, Fowler-4	Ross
8, Jan 30	Earth inner structure, receiver functions, tomography	Chapter 2, Fowler-4	Ross
9, Feb 4	Earthquake scaling and focal mechanisms, InSAR	Chapter 2, Fowler-4	Ross
10, Feb 6	Heat flow and plate cooling	Chapter 3, Fowler-7	Ross
11, Feb 11	Heatflow problems, midterm review and essay discussion	Chapter 3, Fowler-7	Ross
12, Feb 13	**Midterm**		
13, Feb 18	Gravity and the shape of the Earth	Chapter 4, Fowler-5	Steve
14, Feb 20	Gravity and geoid anomalies	Chapter 4, Fowler-5	Steve
15, Feb 25	Moments of inertia, geoid, rotational dynamics	Chapter 4, Fowler-5	Steve
16, Feb 27	Geomagnetism; main field	Chapter 5	Steve
17, Mar 3	Dynamos, secular variation	Chapter 4	Steve
18, Mar 5	Paleomagnetism and plate tectonics	Chapter 4	Steve
19, Mar 10	Electromagnetic Methods	-	Steve
20, Mar 12	Class Review and essays due	-	Steve & Ross
Mar 17	**Final**		

Appendix to Syllabus

Academic integrity

Academic Integrity is expected of everyone at UC San Diego. This means that you must be honest, fair, responsible, respectful, and trustworthy in all of your actions. Lying, cheating or any other forms of dishonesty will not be tolerated because they undermine learning and the University's ability to certify students' knowledge and abilities. Thus, any attempt to get, or help another get, a grade by cheating, lying or dishonesty will be reported to the Academic Integrity Office and will result sanctions. Sanctions can include an F in this class and suspension or dismissal from the University. So, think carefully before you act by asking yourself: a) is what I'm about to do or submit for credit an honest, fair, respectful, responsible & trustworthy representation of my knowledge and abilities at this time and, b) would my instructor approve of my action? You are ultimately the only person responsible for your behavior. So, if you are unsure, don't ask a friend – ask your instructor, instructional assistant, or the Academic Integrity Office. You can learn more about academic integrity at `academicintegrity.ucsd.edu` .

Students with Disabilities

Students requesting accommodations for this course due to a disability must provide a current Authorization for Accommodation (AFA) letter issued by the Office for Students with Disabilities (OSD) which is located in University Center 202 behind Center Hall. Students are required to present their AFA letters to faculty (please make arrangements to contact your professor privately) and to the OSD Liaison in the department in advance so that accommodations may be arranged. Contact the OSD for further information (858-534-4382, osd@ucsd.edu, or `disabilities.ucsd.edu`).

Student Affairs

Throughout your time at UC San Diego, you may experience a range of issues that can negatively impact your learning. These may include physical illness, housing or food insecurity, strained relationships, loss of motivation, depression, anxiety, high levels of stress, alcohol and drug problems, feeling down, interpersonal or sexual violence, or grief. These concerns or stressful events may lead to diminished academic performance and affect your ability to participate in day-to-day activities. If there are issues related to coursework that are a source of particular stress or challenge, you may speak with your professor, so that they are able to support you. UC San Diego provides a number of resources to all enrolled students, including:

- Counseling and Psychological Services (858-534-3755 – `caps.ucsd.edu`)
- Student Health Services (858-534-3300 – `studenthealth.ucsd.edu`)
- CARE at the Sexual Assault Resource Center (858-534-5793 – `care.ucsd.edu`)
- The Hub Basic Needs Center (858-246-2632 – `basicneeds.ucsd.edu`)

We care about you at UC San Diego, and there is always help available.

Copyright

All course materials (class lectures and discussions, handouts, examinations, web materials) and the intellectual content of the course itself are protected by United States Federal Copyright Law, the California Civil Code. The UC Policy 102.23 expressly prohibits students (and all other persons) from recording lectures or discussions and from distributing or selling any course materials without the prior written permission of the instructor. Students are permitted to make notes solely for their own private educational use. Exceptions to accommodate students with disabilities may be granted with appropriate documentation. See `policy.ucop.edu/doc/2710530/PACAOS-100` .