

PTYS 512: Planetary Global Tectonics

Fall 2022

Kuiper room 312, Tuesday/Thursday, 9:30-10:45

Course Description

This course will provide an overview of planetary geodynamics. The lectures will focus on developing a theoretical understanding of the physical processes that govern planetary evolution, including the generation of heat, conductive and convective heat transfer, elasticity, stress and strain, flexure of the lithosphere, analysis and interpretation of gravity data, seismology, and fluid dynamics. The theory will be applied to problems related to the evolution and structure of the solid planets and moons in the solar system.

Instructor Information

Dr. Jeff Andrews-Hanna

Kuiper 438

617-833-8754

jcahanna@arizona.edu (preferred mode of contact)

preferred name: "Jeff"

preferred pronouns: he, him, his

Office hours: Tuesday, 2:00-3:00 PM (in-person or remote)

I am also available to meet at other times – please e-mail to set up a meeting either during office hours or at another time.

Web information: This course will use a D2L page:

<https://d2l.arizona.edu/d2l/home/1209716>

Learning outcomes

Students will demonstrate a quantitative understanding of the physical processes governing planetary evolution.

Students will be able to solve quantitative problems in planetary geodynamics using analytic and numerical methods.

Required texts and materials

Geodynamics (Turcotte and Schubert, 2nd edition)

Available for free in pdf form from the UA library (but it is a good book to have on your shelf):

<https://www-cambridge-org.ezproxy4.library.arizona.edu/core/books/geodynamics/D20BD7359E157591F75CF3BCFEDF88A8>

Schedule of topics and activities

See course schedule at end of syllabus

Assessments

The different components of the course will be weighted as follows:

Homework: 40%

Exams: 15%, 15%, 30%

Exams: This course will have two mid-term exams and a final exam. Exams will be in-person, unless circumstances require a change in teaching mode. Either remote or in-person exams will be conducted during the regular class period or the scheduled final exam period. You may prepare and use a single-sided 8x10 page of handwritten notes to use during the exam (2 pages for the final exam).

The nominal plan for exams (to be updated as needed) is as follows:

In-person exams: You may bring one page of handwritten notes to the exam.

Remote exams: (only if it becomes necessary) Exams must be completed during the class period or the scheduled final exam period. You may use your course notes or textbook during the exam. Use of the internet is strictly prohibited.

The university final exam schedule can be found at:

<https://registrar.arizona.edu/faculty-staff-resources/room-course-scheduling/schedule-classes/final-exams/final-exams-fall-2022>

The final exam is currently scheduled for Tuesday, 12/13 from 8:00-10:00 AM.

Homework: Regular problem sets will be assigned approximately every other week. Assignments will require quantitative problem solving. You are encouraged to use *Matlab* for these assignments (and some assignments will require *Matlab*-based functions), so that we have a uniform programming language for ease of grading and assistance by the professor, but any programming language is acceptable. A *Matlab* tutorial will be provided. While many questions could be answered using a spreadsheet-based program such as *Excel*, these programs are not effective for answering most questions and are particularly prone to errors in setting up complex equations. For all problems, show all work, including written-out versions of equations used with explicit statements of the values and associated units used for each variable in the equation. Include any code used in your solution (though the written non-code answers must be complete and stand on their own).

You are permitted to consult with your fellow students or the professor for assistance in completing homework assignments (unless instructed otherwise), but your work must be your own. Exchanging code is not permitted. Obtaining and using homework or exams from previous years is not permitted.

In the alternate weeks, mini-research projects will be assigned. More details to follow.

Equipment and software requirements: For this class you will need access to the following hardware and software:

- A computer with *Matlab* or equivalent program for homework assignments. Matlab is available to University of Arizona students free of charge.
<https://softwarelicense.arizona.edu/mathworks-matlab>
<https://www.mathworks.com/academia/tah-portal/university-of-arizona-30356115.html>
- If a switch to remote/online lecture is required, you will need a computer or tablet with *Zoom* installed, with a webcam and microphone for on-line participation

If you experience any technology issues that may impede your participation in the course, please let me know as early in the semester as possible

Grading Scale and Policies

Numerical grades will be curved. Letter grades will nominally be assigned based on the following distribution:

- A: 90% and higher
- B: 80-89%
- C: 70-79%
- D: 60-69%
- F: <60%

Meeting times: Given the current state of the pandemic and university policy, this course will be meeting in-person. If a change to remote teaching becomes necessary, we will meet by *Zoom*. Stay-tuned for updates as the semester progresses. The class will meet Tuesdays and Thursdays from 9:30-10:45 AM MST in Kuiper room 312.

Health and safety precautions: As we enter the Fall semester, the health and well-being of everyone in this class is the highest priority. Accordingly, we are all required to follow the university guidelines on COVID-19 mitigation. Please visit:

www.covid19.arizona.edu

for the latest guidance.

- **Face coverings:** Per current UArizona guidelines, face coverings are not required in the classroom. Any changes in university policy will be announced and strictly enforced. Students are welcome and encouraged to wear a mask at any time.
- **Physical distancing:** Per current UArizona guidelines, physical distancing is not required in the classroom. However, physical distancing can help to prevent the spread of disease and is recommended by the CDC at medium to high levels of community transmission.
- **Respecting others:** It is important to recognize that each individual has a unique situation with respect to their risk of both illness and transmission to others. Within the limitations of university policy and CDC guidelines, it is important to respect the choices of others, including the choice to wear a mask and/or physically distance.
- **Special COVID-19 accommodations:** If you feel you are at increased risk or are concerned regarding your risk of transmitting the disease to others, please contact the professor to discuss options.
- **Classroom attendance:**
 - If you feel sick, or may have been in contact with someone who is infectious, stay home. Except for seeking medical care, avoid contact with others and do not travel. At-home antigen tests commonly give negative results for the first few days of illness during which a person may be highly contagious.
 - Notify your instructors if you will be missing an in person or online course.
 - Campus Health is testing for COVID-19. Please call (520) 621-9202 before you visit in person.
 - Visit the UArizona COVID-19 page for regular updates.

Academic advising: If you have questions about your academic progress this semester, or your chosen degree program, please note that advisors at the [Advising Resource Center](#) can guide you toward university resources to help you succeed.

Life challenges: If you are experiencing unexpected barriers to your success in your courses, please note the Dean of Students Office is a central support resource for all students and may be helpful. The [Dean of Students Office](#) can be reached at 520-621-2057 or DOS-deanofstudents@email.arizona.edu. If you are being directly or indirectly affected by the ongoing pandemic in such a way that it affects your performance in this class, please speak with the instructor.

Physical and mental-health challenges: If you are facing physical or mental health challenges this semester, please note that Campus Health provides quality medical and mental health care. For medical appointments, call (520)-621-9202. For After Hours care, call (520) 570-7898. For the Counseling & Psych Services (CAPS) 24/7 hotline, call (520) 621-3334.

University policies

All university policies related to a syllabus are available at:

<https://academicaffairs.arizona.edu/syllabus-policies>

Policies pertain to absence and class participation, threatening behavior, accessibility and accommodations, the code of academic integrity, and the non-discrimination and anti-harassment policy.

Land acknowledgement

The University of Arizona resides on ancestral lands of the Tohono O’odham and Pascua Yaqui nations, where many today continuously reside in their ancestral land. I acknowledge the privilege it is to teach and learn in this region and I express my gratitude to these nations. I also acknowledge the historical and present-day injustices that many indigenous peoples have suffered at the hands of those in power, including the loss of their ancestral lands, and the grave inequities that persist today as a result.

Preferred pronouns

This course affirms people of all gender expressions and gender identities. If you prefer to be called a different name than what is on the class roster, please let me know. Feel free to correct instructors on your preferred gender pronoun. If you have any questions or concerns, please do not hesitate to contact me directly in class or via email. If you wish to change your preferred name or pronoun in the UAccess system, please use the following guidelines:

University of Arizona students may choose to identify themselves within the University community using a preferred first name that differs from their official/legal name. A student’s preferred name will appear instead of the person’s official/legal first name in select University-related systems and documents, provided that the name is not being used for the purpose of misrepresentation. Students are able to update their preferred names and pronouns in UAccess. To change your listed pronoun on UAccess, navigate to the Student Self Service page, go to the personal information section, and click on “Names”. Options include (he, him, his), (she, her, hers), (they, them, theirs), (xe, xem, xyr), and (ze, zir).

Classroom community

My goal is to establish this class as a community of mutual respect. I believe that diversity is a critical part of science – diversity of ideas, diversity of perspectives, and diversity of individuals. I appreciate the fact that each student brings their own history and perspective to the class. I recognize that many in our campus community have faced discrimination and bias throughout their educations and their lives, particularly people of color, other under-represented minorities, and immigrants. I expect that each person in this class will treat everyone else with respect at all times. If at any time you feel that I have failed to treat you with respect, I ask you to speak with me to help me to understand my failing or to clear up any misunderstanding.

Sexual harassment

The University of Arizona is committed to removing educational barriers created by sex discrimination and sexual harassment. Sex discrimination under Title IX can include acts of violence based on sex, such as sexual assault, domestic violence, dating violence, and stalking. If you (or someone you know) has experienced or experiences any of these incidents, you have options for help at the University. The University of Arizona has staff members trained to support you in navigating campus life, accessing health and counseling services, providing academic and housing accommodations, helping with legal protective orders, and more.

Please be aware that UA faculty and instructors who work with students are required to report allegations of sex discrimination to the Title IX Office. This means that if you tell me about a situation involving sexual harassment, sexual assault, dating violence, domestic violence, or stalking that involves another student or employee, or that happens on campus or in a UA program, I must share that information with the Title IX Coordinator. Although I have to make that notification, you will have choices regarding whether or not you want to pursue a formal complaint against anyone on campus. Our goal is to make sure you are aware of the range of options available to you and have access to the resources you need.

If you wish to speak to someone privately, you can contact any of the following on-campus resources:

- Counseling & Psych Services (CAPS), <https://health.arizona.edu/counseling-psych-services>, 520-621- 6490, 520-570-7898 (after hours)
- Oasis Sexual Assault, Relationship Violence, and Trauma Services, <https://health.arizona.edu/counseling-oasis> (same phone as CAPS)
- Campus Health, <https://health.arizona.edu/home>, (520) 621-6490
- University of Arizona Ombuds, <https://ombuds.arizona.edu/>, (520)-626-5589
- Title IX section on sexual assault support & resources (<https://titleix.arizona.edu/title-ix/sexual-harassment-violence>) has more information, as well as a link explaining options if you have a concern, need assistance/support, or would like to file a complaint.

Reporting of harassment

If a student has any concerns related to this class or this department, they are encouraged to bring them to either the instructor of this class, the Department Head or Assistant Department Heads, or the chair of the Graduate Advising and Admissions Committee.

The University of Arizona policy on discrimination and harassment can be found at: <https://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>

An individual who believes that they have been subjected to discrimination, harassment, or retaliation in violation of this policy should report the matter immediately as set forth below to obtain information about resolving concerns, including complaint-filing options and procedures, and to enable the University to take prompt remedial action. If the alleged policy violator is a University student, the individual who has been the subject of discrimination, harassment, or retaliation in violation of this policy should contact:

Dean of Students, (520) 621-7057, dos-deanofstudents@email.arizona.edu

Director for Equity Compliance, (520) 621-9449, equity@email.arizona.edu

Good Faith Allegations. Because of the nature of discrimination, harassment, or retaliation complaints, allegations often cannot be substantiated by direct evidence other than the complaining individual's own statement. Lack of corroborating evidence should not discourage individuals from seeking relief under this policy. No adverse action will be taken against an individual who makes a good faith allegation of discrimination, harassment, or retaliation under this policy, even if an investigation fails to substantiate the allegation. However, individuals who make dishonest statements or make statements with willful disregard for the truth during an investigation or enforcement procedure under this policy may be subject to disciplinary action in accordance with existing University policies.

Anonymous Inquiries and Complaints. Members of the University community may contact the Office of Institutional Equity or the Dean of Students Office at any time to ask questions about discrimination, harassment, retaliation, or complaint-filing procedures and may provide information without disclosing their names. This provision does not relieve managers, supervisors, instructors, or advisors of their responsibility to promptly report under this policy.

Confidentiality. Employees of the Office of Institutional Equity, employees of the Dean of Students Office, and all responsible administrators who receive reports of discrimination, harassment, or retaliation shall maintain the confidentiality of the information they receive, except where disclosure is required by law or is necessary to facilitate legitimate University processes, including the investigation and resolution of discrimination, harassment, or retaliation allegations.

Reporting Complaints to Outside Agencies. University employees and students have the right to file discrimination, harassment, and/or retaliation complaints with outside agencies as well as with the University's Office of Institutional Equity or the Dean of Students Office. If an individual files a complaint with an external agency, the filing will not affect the University's investigation concerning the same or similar events.

Subject to Change Statement

Work and course requirements are subject to change at the discretion of the instructor with proper notice to the students.

Provisional lecture schedule: *(subject to change)*

Lecture	date	day	Lecture topic	Assignments
1	8/23/22	T	Intro and overview	
2	8/25/22	R	Heat flow - static	
3	8/30/22	T	Heat flow - static	
4	9/1/22	R	Heat flow - dynamic	
5	9/6/22	T	Heat flow - dynamic	
6	9/8/22	R	Heat flow - dynamic	Hwk 1 (static heat flow) due
7	9/13/22	T	Heat flow - finite differences	
8	9/15/22	R	Heat flow - planetary applications	IRP 1 - static heat flow
9	9/20/22	T	Stress, strain and elasticity	
10	9/22/22	R	Elasticity and flexure	Hwk 2 (dynamic heat flow)
11	9/27/22	T	Flexure	
12	9/29/22	R	Applications of flexure	IRP 2 - dynamic heat flow
13	10/4/22	T	Applications of flexure	
14	10/6/22	R	EXAM 1	EXAM 1 - heat flow, stress, strain
15	10/11/22	T	Fourier series and flexure	
16	10/13/22	R	Gravity basics	Hwk 3 - elasticity and flexure
17	10/18/22	T	Gravity analyses	
18	10/20/22	R	Gravity - spherical harmonics	IRP 3 - elasticity and flexure
19	10/25/22	T	Gravity analyses	
20	10/27/22	R	Gravity - planetary applications	Hwk 4 - gravity
21	11/1/22	T	Gravity - planetary applications	
22	11/3/22	R	EXAM 2	EXAM 2 - flexure, gravity
23	11/8/22	T	Gravity - planetary applications	
24	11/10/22	R	Tectonics	IRP 3 - gravity
25	11/15/22	T	Rheology	
26	11/17/22	R	Fluid mechanics	IRP 4 - tectonics
	11/22/22	T	Thanksgiving - no class	
	11/24/22	R	Thanksgiving - no class	(Thanksgiving)
27	11/29/22	T	Fluid mechanics	
28	12/1/22	R	Mantle convection, cores	Hwk 5 - fluid mech., mantle convection
29	12/6/22	T	wrap-up	