SIOG 234 - Geodynamics - Sandwell [SP24]

✎ Edit

SYLLABUS

DATE	TOPIC	READING/HOMEWORK
	Review complex numbers and contour integration	**Problems** (http://topex.ucsd.edu/ge
	Plate Tectonics	
01 APR	Class Overview **1.1 Plate tectonic observations** (https://drive.google.com/file/d/18Zc3dobZoOibYu91WtiGJwL2Ds20YwTi/view?usp=share_link) **KML files** (http://topex.ucsd.edu/geodynamics/tectonics.kmz)	Read: T&S, Ch. 1.1 to 1.14 or **HW1 Ex. 1.1 - 1.5**
03 APR	3.1 - 3.2 Plate Tectonic - Theory	Read: The Ocean basins: Their Stru Reading Room) **Reference: MORVEL Tectonic Mo** (http://topex.ucsd.edu/geodynamics/
05 APR	3.3 - 3.7 Plate Motions on a Sphere	Functions of a Complex Variable (re **Matlab Tutorial** (http://www.matl **Python Tutorial** (https://swca gapminder/)
04 APR	Optional Math Review: **book** (https://canvas.ucsd.edu/courses/55995/files/11892551/download?wrap=1), **review** (https://canvas.ucsd.edu/courses/55995/files/11892541/download?wrap=1), solutions	
08 APR	2.1- 2.4 Fourier Transforms	**HW2 Ex. 3.1, 3.3- 3.5**
10 APR	2.5 - 2.7 Fourier Transforms	**HW3 Ex. 2.3 - 2.9**
12 APR	In class closed book Quiz 2 problems on plate tectonics 2 problems from math review	
15 APR	4.1 - 4.6 Marine Magnetic Anomalies Plate Motions and Reconstructions	**View Videos on Plate Tectonics** (http://www.soest.hawaii.edu/wessel/ Maria Seton Dick Hey John Tarduno
	Heat Flow	
17 APR	Heat Conduction, Heat Flow Measurements, and Global Heat Budget	**HW4** (http://topex.ucsd.edu/geodynamics/h **Papers for HW4** (https://topex.ucsd.edu/p **HW4 signup** (https://docs.google.com/document/ Read: T&S, Ch. 4.1 to 4.19
19		

19 APR	Continental and Oceanic Geotherms	
22 APR	5.1 - 5.3 Cooling of the Oceanic Lithosphere	
24 APR	5.4 - 5.4 Thermal Subsidence	Doin and Fleitout, EPSL, 1996 (http://topex.ucsd.edu/geodynamics/ Hillier and Watts, JGR, 2005 (http://topex.ucsd.edu/geodynamics/
26 APR	5.5 Plate cooling model 5.6 Buoyancy of the Lithosphere	**HW5** - Problems from T&S, Ch. 4: 4
29 APR	Lithosphere Subduction on the Earth and Venus Cooling of a Lava Lake (Stefan Problem) (http://www.swisseduc.ch/stromboli/perm/erta/movies-en.html) (07cooling.pdf)	
01 MAY	6.1 - 6.5 Review Stress and Strain	Solutions to Exercises 6.1 (http://to (http://topex.ucsd.edu/geodynamics/
03 MAY	Student presentations of HW4	Read T&S, Ch3.1 to 3.9
	Isostasy, Rheology, and Flexure	
06 MAY	7.1 - 7.6 Isostasy and Swell Push Force	Flesch et al., 2001 (http://topex.ucs T&S, Ch 3.9 to 3.12 **HW6 - Ex. 7.5 and 7.6 and Proble** **3-1, 3-7, 3-14, 3-19, 3-22**
08 MAY	Moment vs. Curvature 8.1 - 8.3 Flexure Theory	Burov and Watts (http://topex.ucsd Burgmann and Dresen_2008 (http://topex.ucsd.edu/geodynamics/ HW7 (http://topex.ucsd.edu/geodyna Flexure Papers for HW7 (https://topex.ucsd.edu/pub/class/ge HW7 sign up (https://docs.google.com/document/ usp=share_link&ouid=115663402152
10 MAY	7.6 Rheology of the Lithosphere	Read: T&S, Ch. 3.13 to 3.18
13 MAY	9.1 - 9.3 Flexure Examples	Read: T&S Ch. 8.1 to 8.9
	Earthquakes	

15 MAY	7.6 Rheology of the Lithosphere	
17 MAY	10.1 - 10.3 Strike-slip fault: deformation and moment	
20 MAY	Earthquake Cycle	
	Gravity	
22 MAY	12.1 - 12.2 Global Gravity 13.1 - 13.5 Reference Earth Model	Read: Watts, JGR, 1978 (http://top
24 MAY	15.1 - 15.3 Laplace's Equation	
29 MAY	16.1 - 16.6 Poisson's Equation and Bouguer Anomalies	**HW8 - Ex. 12.1, 12.5, 15.1, 16.1, 1**
31 MAY	17.1 - 17.7 Gravity/topography transfer function and Isostatic geoid anomalies	Read: T&S, Ch. 6.1 to 6.10
	Fluid Mechanics	
03 JUN	T&S 6.1-6.10 Channel Flow and Stream Function	
05 JUN	18.1 - 18.3 Postglacial Rebound	**HW9 - T&S 6., 6.3, 6.6, 6.11** **EX - 17.1, 17.2, 19.3**
07 JUN	19.1 - 19.6 Driving Forces	

Description: Welcome to Geodynamics. In this course we will use the tools of math and physics to investigate the dynamics and kinematics of the solid Earth. The main topics include: plate tectonics, lithosphere heat transport, isostasy/lithospheric flexure, earthquake cycle, gravity, and plate driving forces.

Goals: The main objective of the course is to develop the skills needed to reproduce published research and provide a critical assessment. We will learn to use the tools of calculus and Fourier transforms to solve a variety of linear partial differential equations in Cartesian coordinates.

Design and Assessment: The course will be a mix of lectures, weekly homework, a quiz, and two student presentations. The grades are based on 10 points for each homework/quiz problem usually due on Mondays. The student presentations

are 50 points each. Look in the ***Media Gallery*** (https://canvas.ucsd.edu/courses/55995/external_tools/82) area for recorded lectures from 2020.

Texts, publications, and programming languages: We will follow the textbook *Geodynamics* by Turcotte and Schubert (2nd or 3rd edition) as well as ***Advanced Geodynamics*** (https://drive.google.com/file/d/18Zc3dobZoOibYu91WtiGJwL2Ds20YwTi/view?usp=share_link) by Sandwell (2022). In addition, student presentations will be based on classic publications. Computer homework can be done using MATLAB or Python.

Policies: There will be a deduction for late homework (10% for one day and a maximum of 30% for 3 days or more). Working in groups on homework is encouraged but do your own work in the end. It is embarrassing if everyone gets the same wrong answer so alternate approaches are encouraged. If you use ChatGPT, please note this in any homework and do not copy/paste text or equations.

Instructor: David Sandwell; 1102 IGPP; **dsandwell@ucsd.edu** (mailto:dsandwell@ucsd.edu) ; Cell. 858-663-9426; zoom **https://ucsd.zoom.us/j/9566699054** (https://ucsd.zoom.us/j/9566699054)

Office Hours: There are no formal office hours but Sandwell will be in the classroom, or on zoom, 30 minutes prior to each lecture. For other meetings send e-mail.

SIO 234 SUGGESTED BOOKS:

Textbooks:

Geodynamics: Second Edition, Turcotte, D. L. and Schubert, G., Cambridge University Press, 2002.
or
Geodynamics: Third Edition, Turcotte, D. L. and Schubert, G., Cambridge University Press, 2014.

Advanced Geodynamics: Fourier Transform Methods, Sandwell, D. T., Cambridge 2022. (https://drive.google.com/file/d/18Zc3dobZoOibYu91WtiGJwL2Ds20YwTi/view?usp=share_link)

Reference Books:

Mantle Dynamics: Mantle Convection in the Earth and Planets, Schubert, G., Turcotte, D. L. and P. Olson, Cambridge University Press, 2001

Fourier Transforms: The Fourier Transform and its Application, Bracewell, R. N., McGraw-Hill Book Co., New York, 1978. (Chapters 2, 6)

Marine Geophysics: The Ocean Basins: Their Structure and Evolution, The Open University , Pergamon Press, 1989. (Chapters 2, 3)

General Ref.: Physics of the Earth, Stacey, F. D., John Wiley & Sons, New York, 1969.
