

GEODYNAMICS- SIO 234

<http://topex.ucsd.edu/geodynamics>

A general course on the dynamics and kinematics of the solid earth based on the text of Turcotte and Schubert.

Prerequisite: some familiarity with (or willingness to learn) partial differential equations and fourier transforms.

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Lecture course, 4-units, letter grade or S/U grade, homework, presentations, quizzes, final.

MWF, 8:50 - 9:40 AM, - Munk Conference Room

SYLLABUS

DATE	TOPIC	READING/HOMEWORK	LECTURER
24 SEP	Review complex numbers and contour integration	Problems	
	<i>Introduction and Plate Tectonics</i>		
25 SEP	Class Overview Plate Tectonics - Observations KML files	Read: T&S, Ch. 1.1 to 1.14 or Plate Tectonics, S,T&O, Ch. 2. HW1	Sandwell
28 SEP	Plate Tectonic - Theory Plate Map	Read: <i>The Ocean basins: Their Structure and Evolution</i> , Chapter 2 (in IGPP Reading Room) Reference: MORVEL Tectonic Model	Sandwell
30 SEP	Applications of Fourier Transforms	Functions of a Complex Variable (review); Matlab Tutorial HW2 - Due Oct 9	Sandwell
02 OCT	Marine Magnetic Anomalies		Sandwell
05 OCT	Quiz: Plate Tectonics		
	<i>Heat Flow</i>		
07 OCT	Heat Conduction, Heat Flow Measurements, and Global Heat Budget	Read: T&S, Ch. 4.1 to 4.19 View Videos on Plate Tectonics Maria Seton Dick Hey John Tarduno	Sandwell
09 OCT	Continental and Oceanic Geotherms	 HW3 - publications for HW3	Sandwell
12 OCT	Cooling of the Oceanic Lithosphere	Read: T&S, Ch. 4.19 to 4.26 HW4 - Problems from T&S, Ch. 4 4-9, 4-10, 4-14, 4-23, 4-24, 4-36, 4-37 DUE 19 OCT	Sandwell
14 OCT	Ocean Floor Topography	Read: Hasterok, 2013	Sandwell
16 OCT	Depth versus age Buoyancy of the Lithosphere;	Parsons and Sclater, JGR, 1977 Stein and Stein, Nature, 1992 Doin and Fleitout, EPSL, 1996 Hillier and Watts, JGR, 2005	Sandwell
19 OCT	Dikes and sills; Cooling of a Lava Lake (Stefan Problem) Summary of Boundary Layer Cooling	Read: Lateral Plate Shrinkage	Sandwell
	<i>Isostasy, Rheology, and Flexure</i>		
21 OCT	Isostasy and Crustal Thickness ; Review Stress and Strain	Schubert and Sandwell, 1989 Flesch et al., 2001	Sandwell
23 OCT	Rheology of the Lithosphere Moment vs. Curvature	Brace and Kohlstedt, JGR, 1980 Burov and Watts	Sandwell

		Burgmann and Dresen 2008	
26 OCT	Flexure Theory		Sandwell
28 OCT	Flexure Examples	Read: T&S, Ch 3.1 to 3.12 HW5 - Problems from T&S, Ch. 3 3-1, 3-7, 3-14, 3-19, 3-22 DUE 06 NOV	Sandwell
30 OCT	Presentations of heat flow problems	Read: T&S, Ch. 3.13 to 3.18	I- Becker, Gustafson A2 - Mayer, Rosa D-Blatter, Shen
02 NOV	Presentations of heat flow problems	HW6 - publications for HW6	F- Oller, House C- Adusumilli, Singleton B- Chaparro, Oshea
	Earthquakes		
04 NOV	Presentations of heat flow problems	Read: Interseismic deformation due to strike-slip faults Read: T&S Ch. 8.1 to 8.9	G-Wang, Hu A1 - Asefaw, Jones
06 NOV	Strike-slip fault: deformation and heat flow	Read: Heat Flow Paradox Kang DiPerna	Sandwell
09 NOV	Earthquake Tools: GPS, INSAR, Strain	Pinon Field Guide	Sandwell
11 NOV	Field Trip to Pinon Flat Observatory Quadcopter survey of E-W strain meter tube		
	Gravity		
13 NOV	Global Gravity Reference Earth Model	Read: T&S, Ch. 5.1 to 5.5 HW7 - Due 30 NOV	Sandwell
16 NOV	Laplace's Equation and Satellite Altimetry	Read: Watts, JGR, 1978	Sandwell
18 NOV	Presentations for HW6		
20 NOV	Presentations for HW6		
23 NOV	Poisson's Equation and Bouguer Anomalies		Sandwell
25 NOV	Gravity/topography transfer function Isostatic geoid anomalies	Read: T&S, Ch. 6.1 to 6.10	Sandwell
	Fluid Mechanics		
30 NOV	Channel Flow and Stream Function	HW8 - Problems from T&S, Ch. 6 6-1, 6-3, 6-6, 6-11 Due Dec 10	Sandwell
02 DEC	Postglacial Rebound		Sandwell
04 DEC	Guest Lecture - Mantle Convection		Stegman?
09 DEC 9:00- 11:00	Final Exam - questions will be taken from previous Geophysics Departmental Exams	All previous exams are on-line at ?	Sandwell

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.

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.

Computer Homework:

Computer homework can be done using Fortran, C, or *MATLAB* which runs on most machines. If you do not have a computer account we will set you up.
