
*Physics of Earth materials - SIO 225 *

<http://igppweb.ucsd.edu/~fialko/sio225.html>

An introduction to the mechanics of continua, including theory of elasticity, brittle failure, fluid dynamics, and viscoelasticity, with applications to geodynamic problems.

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

Instructor: Yuri Fialko <<http://igppweb.ucsd.edu/~fialko>>; 321 IGPP;
yfialko-at-ucsd.edu; Ph. 822-5028
Lecture course, 4-units, letter grade or S/U grade, homework, final exam.
Time: Mon Wed Fri, 1:00-1:50 PM, 303 IGPP - Munk Conference Room

class@ucsd.edu

<<mailto:mbensonm@ucsd.edu>,dbbrown@ucsd.edu,mrdahn@ucsd.edu,yulevy@ucsd.edu,wneely@ucsd.edu,jmruth@ucsd.edu,dtrugman@ucsd.edu,gzellenak@ucsd.edu>

SYLLABUS

Date	*Topic*	*Reading/Homework*	*Lecturer*
03 OCT	Introduction		
	Read: /Class notes; /Segall, Origins (pp xvii-xxi); Malvern, Chapter 1////	YF	
06 OCT	Tensors	Read: Notes//	YF
08 OCT	Elements of tensor algebra	Read: Notes//	YF
10 OCT	No class	Read:/Malvern, Chapter 2 /	YF
13 OCT	Coordinate transformations	Homework 1	
	Read: Notes // < http://igppweb.ucsd.edu/~fialko/cont_mech/02origin.pdf >		YF
15 OCT	Deformation and rigid body motion	Read: notes < http://igppweb.ucsd.edu/~fialko/cont_mech/Ch3.pdf >; /Malvern, Chapter 2/ //	YF
	/Stress and strain; Conservation laws/		
17 OCT	Strain and rotation	Read:class notes; /Ranalli Ch. 1.4-1.6/	
	YF		
20 OCT	Conservation of mass and the continuity equation		
	Read: Notes	YF	
22 OCT	Conservation of linear momentum		
	Read: Notes//	YF	
24 OCT	Stress; Principal axes and principal values	Homework 2	
	Read: Notes	YF	
27 OCT	Conservation of angular momentum; Equilibrium equations	Read: Notes	YF
29 OCT	Conservation of energy		
	Read: Ranalli, Ch. 2; Malvern, 3.2-3.3; Class notes	YF	
	/Failure/		
31 OCT	Frictional sliding; Mohr-Coulomb failure; Anderson's faulting theory		
	Read: Suppe, pp. 289-294	YF	

03 NOV Rate and state friction Read: Class notes YF
 05 NOV Physics of friction at high (seismic) slip velocities Read:
 Class notes YF
 /Elasticity/
 07 NOV Generalized Hooke's Law Homework 3
 Read: Malvern Ch. 6.1-6.2 YF
 10 NOV Generalized Hooke's Law cont'd
 Compatibility equations Read: Notes YF
 12 NOV Linear elastic solutions for homogeneous deformation
 Read: Malvern Ch. 8.1-8.2 YF
 14 NOV Navier-Cauchy equations of motion Read: Malvern Ch. 8.3-8.4 YF
 17 NOV Waves in elastic media Homework 4
 Read: Class notes YF
 19 NOV St. Venant principle Read: Class notes YF
 21 NOV Theory of dislocations Read: Class notes YF
 /Fluid mechanics/
 24 NOV
 Navier-Stokes equations Read: Malvern Ch. 7.1 YF
 26 NOV Some analytic solutions: plane Couette and Poiseuille flows
 Homework 5
 Read: notes; Malvern Ch. 7.3-7.4 YF
 28 NOV No class: Thanksgiving Holiday Read: YF
 01 DEC Geologic applications (mantle convection, magma flow) Read: Class
 notes YF
 /Viscoelasticity and plasticity/
 03 DEC Constitutive equations for the Maxwell and standard linear
 solids Read: Ranalli Ch. 4.6; Class notes YF
 05 DEC Transient deformation in the Earth's crust and mantle;
 Post-glacial rebound, post-seismic relaxation
 Read: Class notes YF
 08 DEC Deformation of rocks in the ductile regime; Power-law rheology;
 Dislocation and diffusion creep
 Read: Class notes YF
 10 DEC Harmonic excitation and Q; Attenuation of travelling waves Read:
 Class notes YF
 12 DEC Stress concentration; Brittle failure; Elements of fracture
 mechanics Read: Class notes YF
 15 DEC Final exam 11:30 am-2:30 pm YF

SIO 225 SUGGESTED BOOKS (some on reserve at SIO Library):

Textbooks:

/Earthquake and Volcano Deformation/, P. Segall, Princeton University Press, 458 pp., 2010.

/Introduction to the mechanics of a continuous medium/, L. E. Malvern, Prentice-Hall, Englewood Cliffs, NJ, 1969.

Reference Books:

/Rheology of the Earth. Deformation and flow processes in geophysics and geodynamics /Ranalli, G., Allen & Unwin, Boston, MA, 1986.

/Theory of Elasticity/, Landau, L., and E. Lifshitz, Oxford University Press, 1986; (Chapters 1, 3)

/Principles of structural geology/, J. Suppe, Prentice-Hall, Englewood Cliffs, NJ, 1985.

/An introduction to fluid dynamics/, Batchelor, G.K., Cambridge University Press

Computer Homework:

Computer homework can be done most easily by using /MATLAB/ which runs on most machines. If you do not have a computer account we will set you up.

Back to Top <#top>

Last modified: Wed Sep 24 18:54:21 PDT 2014