Geology 9555: Flow of Rocks in Crust and Mantle

Jan 2014

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Course Description:
This is an advanced course in Structural Geology and numerical modeling for graduate students. Topics to be covered in the course will be active research and progress in solid earth geology and geophysics, including: geometrical and kinematic analysis, deformation mechanisms, fabric development and simulation, stress and strength of the lithosphere, and the numerical simulation approach.

Computer software and recommended Reading:
There is no textbook for this course. Course topics will be addressed in class meetings and handouts will be delivered. It is essential that you try not to miss any class sessions. It is recommended that you have the following textbooks available for reference during the course.

Continuum Mechanics and Earth Rheology:
Jiang, D. 2013. Basic Continuum and Micromechanics Applicable to the Deformation of Earth's Lithosphere (unpublished manual).
Karato, S. 2008. Deformation of earth materials. Cambridge University Press.
Ranalli, G. 1995. Rheology of the earth. 2nd edition, Chapman and Hall.
Spencer, A.J.M. 1980. Continuum Mechanics. Longman, London.

Geology:
Passchier, C. W., and Trouw, R. A. J., 1996. Microtectonics. Springer.
Twiss, R. J., and Moores, E. M., 1992. Structural Geology. W.H. Freeman and Company, New York.
Hobbs, B. E., Means, W. D. and Williams, P. F. 1976. An Outline of Structural Geology. John Wiley & Sons. New York.

Computer Software
The course uses the Mathematic application MathCad by Parametric Technology Corporation (PTC) frequently. Please manage to get a copy for yourself. Student copies are available in the Campus Bookstore.

Pre-requisites:
You should have completed undergraduate courses in calculus, physics, and structural geology to take the course, or obtain my permission.

Course format:
Class Meetings: 10:00am and 12:30pm, every Friday except holidays or with alternative arrangements
Place: Room 1053 Biology and Geology Building

Evaluation and Grade:

The grade will consist of 3 parts:

1. Assigned labs 20%
2. Project presentation 30%
3. Project report 40%
4. Participation in discussion 10%

Notes: Lab assignments will be given during the course. A lab is due a week after it is assigned. Send me completed labs electronically by the course email.

Every student must complete a project of his/ her choice which should be related to the course content. This can be either an application of the approach learned in this course to the interpretation or re-interpretation of a set of geological observations or a phenomenon. The data can be either your own or from the literature. It can also be a theoretical investigation of a model that is potentially testable by future geological work.

An oral presentation of the project and a final report are required. The final report is due at 12:00 noon May 1, 2014.

Accessibility Statement
Please contact me if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.

Outlines of class meetings

Topic 1: **Background and Geometrical Analysis**

Jan.17: Session 1: Objectives and Approach

Jan. 24: Session 2: Advanced Orientation Data Analysis

Topic 2: Continuum Mechanics and Application

Jan.31: Session 3: Stress, Strain, and Elasticity

Feb.7: Session 4: Deformation, Strain and Rotation

Feb.28: Session5: Flow, Strain Rate and Vorticity

Mar.7: Session 6: Kinematic Models for Tabular Deformation Zones

Topic 3 : Micromechanical Approach

Mar.14: Session7: Rheology of Lithosphere

Mar.21: Session 8: Rigid-body rotation in viscous flows

Mar.28: Session 9: Deformable Objects in viscous flows

April 4: Oral Presentation of Project