Fall 2015 Geology 4610 John

Structural Geology and Tectonics

GEOL 216/GEOL 318

The purpose of this course is to improve your understanding of deformation of the Earth's lithosphere. This introductory course in structural geology will focus on the three-dimensional nature of structural features, how they relate to tectonic associations and processes, and their basic mechanical development. We will begin the class by taking a series of three daylong field trips to see geologic structures in the field first hand. During those trips you are expected to observe and take careful notes that will be turned in at the end of the day. By the end of the course I hope you will be able to think in three-dimensions, feel comfortable in gathering and working with structural data, and will start to appreciate how basic physical processes influence the primary structure of the Earth's lithosphere.

Pre-requisites:

It is assumed that you have a basic understanding of physical and historical geology, including rock classification, geologic time, and stratigraphy. A working knowledge of trigonometry is essential. Some knowledge of basic mechanics, as developed in the first semester, general physics and chemistry courses is also helpful.

Texts:

The required texts include:

1) Davis, G. H., Reynolds, S.J., and Kluth, C., 2011

'Structural Geology of Rocks and Regions' 3rd edition
(ISBN: 978-0-471-15231-6)

2) Marshak, S., and Mitra, G., 1988

'Basic Methods of Structural Geology'
(ISBN-10: 0130651788 or ISBN-13: 978-0130651785)

Supplementary text:

1) Richard W. Allmendinger, 2015

'Modern Structural Practice: A structural geology laboratory manual for the 21st Century'

download at -

http://www.geo.cornell.edu/geology/faculty/RWA/structur-lab-manual/

Note There are many structural geology texts available including those authored by Fossen, van der Pluijm, Twiss and Moores, and Hobbs, Means and Williams, to name a few. If you are having trouble with a particular topic, check out another from the library, and read through the relevant section(s). They are there for you to use, so enjoy.

Lectures: (MWF 10-10:50 am), Room GEOL 216

The lecture material represents the core of the course. It is therefore important to attend all lectures. I'll try to show slides and overhead projections of geologic structures, maps, cross-sections, etc. to supplement the lecture and text. Questions are welcome at any time. There will be a few homework assignments associated with the lecture material.

Labs: (attend 1 section only; Tuesday 2:10-4:00 pm, Wednesday 2:10-4:00 pm, or Thursday 2:10-4:00 pm), Room 318

The lab is the 'hands-on' part of the course. We will begin lab with 3 field trips to local areas on **Saturday Sept. 12, 26,and October 3, 2015.** If the weather is poor on Friday, we may go on the Sunday of that weekend instead, or cancel and have the final field trip Saturday October 10. You will be responsible to attend each of the field trips, observe structures in the field, and submit your field notebook, and maps at the end of the day for comments.

Some lecture time will be devoted to discussion of the lab work, so that maximum time in the lab is spent working on exercises. **Assignments outside those done in the field are due at the start of lab.** Some lab exercises will require graphical or analytical solutions of simple geometric problems. Other labs will emphasize the study and interpretation of geologic maps, cross-sections, or hand samples of rocks, as these provide the best alternative to visiting structures in the field. Structures and problems studied in the lab will parallel closely material covered in lecture.

Note that materials in the lab must stay there. **Please** do not remove ANY materials from the lab; this will make it impossible for your other 39 classmates to complete an exercise.

Each student should bring the following to lab, starred items on the field trips:

lab manual (Marshak and Mitra)	stereonet
*pencils (hard lead)	*colored pencils

*eraser	*ruler
graph paper	*protractor
*field notebook	*compass
tracing paper (tablet)	calculator

A very fine-tipped felt pen will be necessary for inking cross-sections.

Office Hours:

Professor

John: ESB Room 3010
Tu/Th 9:30-11 or by appointment (bjohn@uwyo.edu; ph. 766-4232)

TA(s)

Office hours TBD

Mat Dunlop
SH Knight/Geology Room 133A
(or by appointment mdunlop@uwyo.edu)

Drew McPeak
SH Knight/Geology Room 316
(or by appointment amcpeak@uwyo.edu)

Field Trips:

Field trips are scheduled for weekend days at the start of the semester (subject to weather). We will leave the parking lot adjacent to nursing (across the street from *Turtle Rock*) at **8:00 AM**, and return by 6 PM. The purpose of each exercise is to allow you to see basic structural features in the field, describe and map them, collect your own structural data, plot them and make your own interpretation. Each field trip will build on the previous one, and will last most of the day. You will be required to attend the trip, carry out the basic exercise, and submit your field notebook at the end of each day, for comments and evaluation.

Examinations:

There will be three lecture exams, during the semester. Each will last one hour, and will be worth 100 points (300 points total for exams). Lab exercises will be handed in and graded (200 points total). The total number of possible points for the course is 500.

1st exam: Friday, October 9

2nd exam: Friday, November 13

3rd exam: during finals week Dec 14-18

Please note: Lab is an integral part of the course. You must pass the lab (C or better grade) to pass the course. Exams given during the semester will include problems similar to those worked for the lab up to that time.

If you have a physical, learning, or psychological disability and require accommodations, please let me know as soon as possible. You will need to register with, and provide documentation of your disability to, University Disability Support Services (UDSS) in SEO, room 109 Knight Hall, 766-6189, TTY: 766-3073.

Outline and Reading

Geology 4610

I. Introduction to structure and tectonics: formation and structure of the Earth

(DRK[1], p. 2-29)

II. Introduction to geologic maps, cross-sections, and basic structural field methods

(DRK, p. 687-696; 711-726; 779-782; M/M Chapters 1 and 9)

III. Primary and non-tectonic structures (sedimentary and igneous)

(DRK, p. 21; 697-711)

IV. Stereographic projections

(DRK, p. 735-747; 751-759; M/M p. 105-110)

V. Force and Stress

(DRK, p. 90-120)

VI. Deformation and strain

(DRK, p. 34-77; 120-147; Yeats-handout, p. 122-130)

VII. Brittle behavior

(DRK, p. 226-248; Yeats-handout, p. 17-41)

VIII. Origin of joints and veins

(DRK, p. 193-225; M/M Chapter 11)

IX. Faults and faulting; nomenclature and description

(DRK, p. 249-259; 267-268; 272-280; 286-293)

X. Fault rocks, fault zone models and kinematic analysis

(DRK, p. 260-266; Yeats-handout, p. 49-58)

[1]DRK – Davis, Reynolds, and Kluth – 'Structural Geology of Rocks and Regions'

XI. Tectonic settings of fault systems:

- thrust and reverse faults (DRK, p. 283-285; 305-320; Yeats (handout, p. 301-368)
- normal faults (DRK, p. 281-283; 285; 321-333; active examples p. 656-681; Yeats (handout, p. 249-300)
- strike-slip faults (DRK, p. 334-343; active examples p. 606-632; Yeats (handout p. 167-244)

XII. Theories and paradoxes of faulting

(DRK, p. 301-303)

XIII. Folds and mechanisms of folding

(DRK, p. 344-368; 375-404; M/M, p. 213-226)

XIV. Deformation mechanisms, microstructures, and penetrative rock fabrics

(DRK, p. 148-190; M/M Chapter 11 - p. 223-246)