Fall 2017 Geology 4610 John

*Structural Geology and Tectonics*

The purpose of this course is to improve your understanding of deformation of the Earth's lithosphere. This introductory class 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. By the end of the course we anticipate 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. In addition, much of what you learn in the course will be used for summer field (GEOL 4717), and worthwhile remembering.

Pre-requisites:

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

Text:

The required texts are:

Davis, G. H., Reynolds, S.J., and Kluth, C., 2012

**‘Structural Geology of Rocks and Regions’ 3rd edition**

(ISBN: 978-0-471-15231-6)

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

**‘Basic Methods of Structural Geology’**

(ISBN: 0-13-065178-8)

Supplementary text:

1) Richard W. Allmendinger, 2015-2017

‘**Modern Structural Practice: A structural geology laboratory manual for the 21st Century’**

download at -

<http://www.geo.cornell.edu/geology/faculty/RWA/structure-lab-manual/structure-lab-manual-full.pdf>

**Note -** There are many structural geology texts available including those authored by Twiss and Moores; Hobbs, Means and Williams; Fossen; van der Pluijm and Marshak, and Yeats 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 will show slides of geologic structures, maps, cross-sections, etc. to supplement the lecture and text. Questions from the class are welcome at any time. There will be a few homework assignments associated with the lecture material.

Labs: (Tuesday, Wednesday 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 **Sept. 16, 23, and Sept 30, 2017.** You will be responsible to attend each of the field trips, observe structures in the field, keep a neat notebook, and submit your field materials in lab for comments and help.

If the weather is poor on any Friday, we may cancel and have the final field trip Saturday, October 7.

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 take any materials from the lab.

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

lab manual (Marshak and Mitra) laminated stereonet (in class)

\*pencils (hard lead) \*colored pencils

\*eraser \*ruler

graph paper \*protractor

\*field notebook \*compass

tracing paper (tablet) calculator

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

Office Hours:

# Professor

# John: ESB Room 3016

Tu/Th 9:30-11

or by appointment (bjohn@uwyo.edu; ph. 307-223-1951)

# TA(s)

# Office hours ESB 3006

# Chris Doorn: TBA

([cdoorn@uwyo.edu](mailto:cdoorn@uwyo.edu))

**Tanner Waggoner: TBA**

([twaggon1@uwyo.edu](mailto:twaggon1@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 (and map) 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: Wednesday, October 4

2nd exam: Wednesday, November 8

3rd exam: Monday, December 18 (10:15-12:15, Room 216)

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

Cell phones in class:

Use of cell phones in class or in the field will not be tolerated. **Just turn them off.**

\*\**Note - Several studies have compared students who texted during a lecture versus those who did not.  Those who texted frequently took lower quality notes, retained less information, and did worse on tests about the material*.

If you have a physical, learning, sensory 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 Disability Support Services (DSS), room 109 Knight Hall. You may also contact DSS at (307) 766-3073 or [udss@uwyo.edu.](mailto:udss@uwyo.edu)  Visit the website for more information: [www.uwyo.edu/udss](http://www.uwyo.edu/udss).

Outline and Reading

Geology 4610

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

(DRK[[1]](#footnote-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)

**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, 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)

1. DRK – Davis, Reynolds, and Kluth – ‘Structural Geology of Rocks and Regions’ [↑](#footnote-ref-1)