

## **GEOL 621: Advanced Structural Geology**

### **Fall 2014**

Structural geology is a study of the character and genesis of deformational structures and their patterns in the earth's crust. Laboratory work includes various trigonometric, geometric, and stereographic methods applicable to structural analysis and presents open-ended geologic problems in geologic, structure contour, and isopach map interpretation.

### **Instructor: Dr. Zeynep Oner Baran**

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Office Hours: M 11:00- 12:00; W 1:00-3:00; make an appointment for out of office hours

### **Recommended Textbook:**

Structural Geology by Hakoob Fossen, Cambridge University Press, ISBN: 978-0-521-51664-8

Structural Geology by Robert J. Twiss and Elridge M. Moores, ISBN: 978-0716722526

**Schedule:** M 11:00-2:00 pm (LAB), Thursday-Friday 12:00-12:50 pm (Lecture/Discussion)

### **Objectives:**

**GEOL 621** is a graduate-level, advanced structural geology course aiming to provide you with the knowledge and skills used in identification and interpretation of deformational structures at different scale on the Earth's crust. Application of basic principles of physics, chemistry, biology, mathematics and earth sciences will be used in construction and interpretation of various structural analyses. Identification of structures on geologic maps and cross-sections, field measurement exercises, discussions on different scientific or technical problems will prepare you for your future career with improving your critical thinking and research skills. Lectures and lab exercises covering the temporal and spatial analysis of structures; kinematics and mechanics of the deformation; significance of rheology on rock deformation and various examples of end-members will help you to feel comfortable while designing and developing scientific and technical research projects in the near future. Observations of micro- to regional-scale structures during the field trips and lab exercises will help you to visualize nature and magnitude of deformation at different scale. Collaborations during the field trips and lab works will increase your ability to work and communicate efficiently with your team members.

The most important goal of this course is to help you develop and improve technical and scientific skills through application of structural analyses, while enjoying what you're learning. Achievement of this goal will be much easier with your collaboration.

### **Course Requirements & Ethics**

#### **1. Field trips**

We will have field trips to practice measurements, interpretations, mapping, cross-sections and you will be responsible for your own data collection in the field. The collected data will be needed for in-class structural analysis after the field trips. Your dataset can be requested for any advance structural analysis exercise later on, so it is very important to collect enough and accurate

data during the field trips. You will be responsible for submitting a field trip report for each trip. Your field trip report should include a detailed geologic map (if a mapping project), cross-sections, outcrop sketches (if needed), unit descriptions, structural plots and illustrations and your interpretation in a professional template.

Your field trip reports will be graded and contribute in your final grade. Participation in field trips is mandatory; unless you have a proved condition that requires you not to be there (Please let me know about the situation ahead of time).

## **2. Laboratory assignments**

During some of the laboratory sessions, you will need to use your own dataset collected during the field trips. You will be also provided with some other datasets for advance analysis techniques. Since this is an advanced level course, we will not have a lecture in the lab sessions, unless it is needed. Laboratory sessions can be used for field trips, discussions regarding the reading material, computational analysis techniques, or demonstrations. The content of structural analysis techniques may reshape and rebuild in order to help the class build a stronger background with spending relatively longer time on specific techniques that might be more relevant and applicable in your research areas.

## **3. Exams**

There will be one mid-term and one final exam for the lecture part of this class. Mid-term exam will include questions from the material covered until the exam day. The final exam will be comprehensive and cumulative, including all of the course material covered throughout the semester. There will be no make-up exams. If you miss an exam due to health problems, an official report from your physician has to be submitted in order to excuse your missing exam. For any other conflicts or problems, you must notify your instructor ahead of time in order to make arrangements. Any exam or assignment missed without an acceptable excuse will be graded as zero. Pop-up quizzes are possible in this class. So, make sure you go over the reading material prior to the class and lab session.

## **4. Homework assignments**

You will be responsible for homework assignments that are prepared to help you understand the content and techniques throughout the semester. Homework assignments must be turned in on or before due date, typed and organized neatly. Late assignments will not be graded and you will get a zero, unless you make an arrangement with your instructor because of an acceptable excuse.

## **5. Attendance policy:**

“Every student is expected to attend each lecture or laboratory session for which he or she is scheduled. The faculty has allowed no system of authorized “cuts.” A student who fails to attend classes regularly must satisfy such requirements as the instructor in a course may prescribe.” (SDSM&T attendance policy)

**6. Cheating (Academic Integrity) policy:**

COPY & PASTE is considered as Plagiarism/cheating! Do not copy-paste others work in this class. Make sure you give appropriate references in your homework assignments, field reports etc.

“High standards of academic honesty and intellectual integrity are essential to the success of our students and the institution. The campus community will not tolerate acts of dishonesty in any academic activities at School of Mines. Such acts jeopardize not only the individual student, but also the integrity and dignity of the institution and its members. The South Dakota Board of Regents has clearly defined those acts that constitute violations of academic integrity (BOR Policy 3.4.2.B.1). These acts include, but are not limited to, cheating, fraud, plagiarism, or knowingly furnishing false information within the academic arena. These acts of dishonesty violate the ethical values the university works to instill in all members of the campus community.”

**7. Withdrawal Grades Policy and Deadline**

“Undergraduate and graduate students who drop a course, or withdraw from the System, shall receive a grade of “W” if that action occurs anytime between the day after the census day for that course and the day that corresponds with the completion of 70 percent of the class days for that course. Likewise, a student who withdraws from the system during that time period also shall receive grades of “W” for all the courses in which he/she is registered. . . . . If a student withdraws from a course after the time period specified, a grade of “F” will automatically be assigned by the Office of the Registrar and Academic Services”. (South Dakota Board of Regents Policy 5:7.2)

**8. Freedom in learning statement:**

*Under Board of Regents and University policy student academic performance may be evaluated solely on an academic basis, not on opinions or conduct in matters unrelated to academic standards. Students should be free to take reasoned exception to the data or views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled. Students who believe that an academic evaluation reflects prejudiced or capricious consideration of student opinions or conduct unrelated to academic standards should contact the dean of the college which offers the class to initiate a review of the evaluation.*

**Electronic devices policy:**

*Please turn off your cell phone before class starts. No text messaging in class. No headphones. Laptop usage for class-related programs only (when requested by the instructor).*

**GRADING**

Mid-term exam 20%

Final exam 20%

Total homework and Laboratory Assignments 20%

Lab Final exam 20%

Field Trip assignments 20 %

## LECTURE CONTENT - in general

Introduction to Structural Geology and Tectonics

Primary (non-tectonic) and Secondary (deformational) structures

Planar and linear structures and interpretation of geologic maps

Structures on geologic maps and cross-sections

Stress analysis, elements and construction of Mohr Diagram

Coulomb failure envelope

Strain analysis

Non-coaxial vs. co-axial deformation; simple vs. pure shear

Rheology and deformation

Brittle deformation; joints

Terminology, kinematics and characteristics of faulting

Types of Faults and related principle stress distribution

Normal faulting and extensional deformation

Thrust faulting and collisional tectonics

Strike-slip tectonics and related structures

Ductile deformation, kinematics and terminology of folding

Fold classification

Foliation and cleavage

Lineations

Shear zones and kinematic indicators