

University of Toronto-Scarborough
Department of Physical and Environmental Sciences
EESC37H3 Structural Geology - Fall 2017

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Office hours: Tuesday 3 pm – 5 pm, EV 466, and by appointment

Teaching Assistant: Yulong Kuai

Lectures: Tuesday, 10 am – 12 pm (Room BV 361)

Labs: Tuesday, 1 pm – 3 pm (Room IC 120)

Overview:

Structural geology is the study of the processes by which rocks deform and evidence of recent and ancient rock deformation events in the Earth's lithosphere. Structures such as folds, faults, mineral fabrics, and the respective patterns occur at a variety of scales and led to changes in shape and configuration of rocks. The various approaches for a structural analysis detailed in this course are:

- Geometric analysis – analysis of the geometry (patterns, shapes and mineral fabrics) of primary structures acquired while the rock was being deposited or emplaced, and secondary structures produced by subsequent deformation
- Kinematic analysis – analysis of the displacement and movements that lead to shape changes (deformation = strain) of rock bodies
- Mechanical and dynamic analyses – reconstruction of forces (stress e.g. magnitude, direction, duration) that led to deformation within a rock body

These help to describe deformation structures, delineate deformation conditions, and better understand deformation processes.

Part of this course is a 2-day field trip to the Bancroft Area (Oct. 21-22, 2017), during which we will see various structures formed under different deformation conditions. This field trip will also allow us to practice practical skills such as rock ID, classification of deformation structures, and interpretation of deformation processes.

Objectives of the course:

The objective of this course is to introduce the fundamentals of structural geology and structural analysis, namely how to:

- Construct and interpret geologic maps
- Conduct descriptive, kinematic, and dynamic analysis of structures
- Develop an understanding of the fundamentals of brittle and ductile deformation of rocks
- Identify and interpret geologic structures in the field

Overall, the course is expected to contribute to inferring deformation processes from observed geologic structures. In addition to unravelling geodynamic processes, the forces which have shaped the Earth's crust, this course will also highlight how deformation processes are related to the formation of natural resource (ore) deposits.

Readings:

Recommended text: Structural Geology – 2nd Ed., 2016, Haakon Fossen, Cambridge Univ. Press

Additional but not required: Structural Analysis and Synthesis: A laboratory course in Structural Geology, Rowland, Duebendorfer, & Schiefelbein, Blackwell Publishing, 3rd Edition. (course reserve)

A dictionary of earth sciences (course reserve)

The facts on file – dictionary of earth sciences (course reserve)

Lecture & Lab Schedule - Subject to change:

Week	Date	Lecture	Lab	Notes
2	Sept. 5	Introduction, Stress & Strain	Lab intro! + Lab 1: geologic maps & cross sections (strike lines)	
3	Sept. 12	Stress & Strain	Lab 2: geologic maps & cross sections	
4	Sept. 19	Changes with depth, brittle deformation (joints, fractures, faults)	Lab 3: Schmidt Net Projections (orientation of planes)	
5	Sept. 26	Brittle deformation (joints, fractures, faults)	Lab 4: Schmidt Net (Folds), block diagram, cross section/map	
6	Oct. 3	Ductile deformation (folds)	Lab 5: Folding + rotations in the Schmidt Net	Quiz 1
7	Oct. 7-13	Thanksgiving – Reading Week		
8	Oct. 17	No Class	Midterm (Tuesday 1-3 pm)	October 21 and 22 for 1-Day Field Trip
9	Oct. 24	Ductile deformation (folds, foliation/lineation)	Lab 6: Schmidt Net (Foliation, lineation, S-C fabric)	
10	Nov. 31	Ductile deformation (Shear zones), Deformation on various scales: Microscopic scale	Lab 7: Shear zones & Schmidt net	Quiz 2
11	Nov. 7	Guest Lecture: TBA		
12	Nov. 14	Deformation on various scales: Regional scale (Contractional regime)	Lab 8: Stress / Strain measurement interpretation, Mohr cycle	Quiz 3
13	Nov. 21	Deformation on various scales: Regional scale (extensional regime & strike-slip regime)	Lab 9: Analog models (orogenic wedge, indenter, flower structures)	
14	Nov. 28	Lab Exam!!!!	Review – Questions for theoretical part of exam	
15	Dec. 7	Study Break & Final Exams		

Marking Scheme:

9 Lab assignments (each 4%)	36%
3 Online Quizzes (each 2%)	6%
1 or 2-Day Field Trip	5%
Midterm (in lab time)	20%
<u>Final Exam (date to be announced)</u>	<u>33% (25% Theory + 8% Lab Exam)</u>
Total	100%

Lectures and Lab exercises:

There will be one two-hour lecture and one two-hour lab period per week. Lecture slides will be posted on blackboard (-> course material)

ALL students are expected to attend ALL lectures. *It is the responsibility of the student to ensure that notes are obtained for any classes missed.*

The purpose of the weekly lab period is to demonstrate practical methods for analysis of structural data and interpretation of geologic maps. **Labs are mandatory for all students and the respective assignments are graded.** During lab you will have a chance to work more independently in order to strengthen your knowledge; during the lectures you'll receive more guidance throughout the material. **Lab assignments are to be completed in one week and submitted at the beginning of the following week's lab.**

The knowledge acquired during the laboratory exercises can also be tested in the **3 Online Quizzes.**

Required lab materials:

- Protractor (drawing circles, measuring angles), calculator with trig function
- A drafting ruler (inches and centimeters), small scissors, pencils, eraser, color pencils
- Graph paper (in millimeters), tracing paper -> can be bought in groups (2-3 students) or as packs in beginning of term from department
- A notebook for tutorials and practice (having some simple drafting paper, without lines or squares, is also very useful for this course)

1 or 2-Day Field Trip – Hastings County (Marmora, Burleigh Falls to Bancroft etc.) – Group Work:

This field trip is mandatory for all students. A fee for transportation will arise, which we will keep as low as possible.

During the field trip groups of 2-3 students will look at the local rock formation, describe and ID these, by filling out a given table. This table will be handed in during the in-class exercise in the week after the field trip (5 % of final grade).

Furthermore, we are outdoors and therefore some preparations are needed:

- Be prepared for any kind of weather (sun vs. rain: rain jacket, sun screen, hat)
- Sturdy footwear (at least running shoes, preferably hiking boots) -> **NO open-toed shoes, sandals, or heels!!!**
- Adequate clothing (long pants, layers, rain cloth)
- Safety goggles or light tinted sun glasses

- Daypack with an adequate amount of water and lunch (+ smaller snack)
- If possible small camera, field book (e.g. small notebook), pencil & pen
- See "Intro to field safety PDF"!

Additional required safety equipment (e.g. hard hats, additional safety goggles) will be supplied by the department.

Additional information will be given in timely manner, as it is still unclear if it will be a 1 or 2-day trip (accommodation, equipment such as sleeping bag etc.)!

Online Quizzes – Individual Work:

Three online quizzes will be posted (see course schedule) and each quiz is 2% (6% total) of final grade. Each quiz will consist of roughly 10-15 questions (multiple choice, True/False).

Study Questions – Group or Individual Work:

I will post a set of study questions on each course topic, which should help you to identify the important course information, study for the quizzes and exams, prepare you for the field trip and to keep on top of the material.

Make Your Own Geo-dictionary (MYOGD) – Group or Individual Work:

A file called "Make your Own Geo-dictionary (MYOGD) is a word document which provides you with important terminology and concepts in Geology. This exercise is not graded, therefore is not mandatory to be finished, but finding the definitions (figures etc.) for these terms will help you to prepare for the exams, quizzes, in-class exercises and later courses. As there are many terms which will be new to you, this can be an overwhelming task to do on your own. It is best to form a group with some of your fellow students to complete the dictionary together. Make sure all of your group mates are on the same page about accuracy and detail. Besides online sources, the appendix of the course textbook, as well as already existing dictionaries for Earth Sciences or Geology (see course reserve) may be useful to find the respective definitions (and figures etc.).

Library Service:

Research Help: University of Toronto Scarborough Library

Staff at the UTSC Library will be happy to help you find the resources you need for your assignments, and learn the research skills you will need for success at university.

Research help is available by phone, e-mail, chat, or in-person in the Library.

For more information, please see the Library's Help Guide for UTSC Students: http://guides.library.utoronto.ca/utsc_help

Need in-depth or department specific assistance? Contact Sarah Forbes, Liaison Librarian for Physical and Environmental Sciences: <http://uoft.me/smforbes>

Blackboard:

Lecture and lab material will be posted on and Online Quizzes will be done through blackboard. Please check daily for updates (e.g. assignments, announcements etc.).

Blackboard: <https://portal.utoronto.ca>

Academic Integrity Statement:

Academic integrity is one of the cornerstones of the University of Toronto. It is critically and important both to maintain our community which honours the values of honesty, trust, respect, fairness and responsibility and to protect you, the students within this community, and the value of the degree towards which you are all working so diligently. According to Section B of the University of Toronto's Code of Behaviour on Academic Matters, which all students are expected to know and respect, it is an offence for students:

- to use someone else's **ideas or words** in their own work without acknowledging that those ideas/words are not their own with a citation and quotation marks, i.e. to commit plagiarism.
- to include false, misleading or concocted **citations** in their work.
- to obtain **unauthorized assistance** on any assignment.
- to provide **unauthorized assistance** to another student. This includes showing another student completed work.
- to submit their own work for credit in **more than one course** without the permission of the instructor.
- to falsify or alter any **documentation** required by the University. This includes, but is not limited to, doctor's notes.
- to use or possess an **unauthorized aid** in any test or exam.

There are other offences covered under the Code, but these are by far the most common. Please respect these rules and the values, which they protect. It is your responsibility to ensure that your work maintains academic integrity. If you have any concerns please see the instructor before a potential problem arises. Please familiarize yourself with the Code (<http://www.governingcouncil.utoronto.ca/policies/behaveac.htm>) and also with the handout "How not to plagiarize", available in the Course Documents section on BB. At the University of Toronto academic dishonesty can result in a *mark of zero, a reduction in final grades, denial of privileges, a monetary fine, failure in the course, suspension, permanent record, a recalling of degrees/diplomas and certificates, or expulsion.*

Accessibility Needs:

The University of Toronto is committed to accessibility. If you require accommodations for a disability, or have any accessibility concerns about the course, the classroom or course materials, please contact Accessibility Services as soon as possible: UTSC campus AccessAbility <http://www.utsc.utoronto.ca/~ability/> or St. George Campus DisAbility disability.services@utoronto.ca or <http://studentlife.utoronto.ca/accessibility>.