

EAS 421 Structural Geology and Tectonics. Fall 2015

Lecture Room & Time:	MWF 10-11, Biological Sciences M137
Labs:	MT 2-5, ESB 4-09, with computer work in ESB 1-39
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About the course

EAS 421 is a second course on the structure of the Earth for third and fourth year students in Geology, Geophysics, and related studies. EAS 421 builds upon the basic techniques of structural description learned in EAS 233 - unconformities, fractures, folds, and fabrics - and examines how these structures are formed in the major belts of deformation that affect the Earth's lithosphere - rifts, orogens, and belts of strike-slip deformation.

Course Description: Geometric, kinematic, and dynamic analysis of structures produced by deformation. Stress and the origin of faults, joints, veins, folds, and tectonites. Brittle and ductile strain in rocks. Extensional, strike-slip, and compressional structural associations. Regional structure, orogens, and crustal tectonics. Lab exercises include structural interpretation for subsurface hydrocarbon and mineral exploration, stereographic techniques for structural analysis, and the study of rock fabrics.

Course Prerequisites: EAS 233 and any 300-level EAS course. Not available to students with credit in EAS 321

Note: by attending classes in EAS 421 you represent that you have completed the above prerequisites, or that you have been granted a waiver of a prerequisite signed by the instructor and the associate chair.

Course Objectives and Expected Learning Outcomes:

From the start of the course we will recognize and apply the following three types of structural analysis:

- **Geometry:** Describe the **shapes and three-dimensional orientations** of structures in the Earth's lithosphere.
- **Kinematics:** Interpret the **movements** that have distorted the lithosphere, over time.
- **Dynamics:** Learn what can (and cannot) be deduced about **forces, stresses, and energy** involved in the deformation of the lithosphere.

Throughout the course it is important to keep these three types of structural analysis distinct.

By the end of the course you should have a broad understanding of the major structures produced by deformation of the Earth's lithosphere in extensional, convergent, and strike-slip environments. You should be able to quantify the geometry and kinematic histories recorded by deformed rocks, and you should be able to explain how these structures were produced by tectonic processes.

The course will alternate between sections that focus on **techniques** for understanding processes at a small scale, and larger-scale examination of **tectonic environments**.

The emphasis in structural geology is on solving problems, not on learning facts. For these reasons, the laboratory sessions are particularly important.

Classes

Lectures

- Be respectful of your instructor and other students by being on time and by not talking or causing other distractions in class.
- If you carry a cell phone make sure it is off during lectures.
- If you have to miss a lecture for medical or another unavoidable reason, try to have a 'lecture buddy' who can make notes for you and collect any handouts. I do not bring copies of previous handouts to subsequent lectures.
- Recording is not permitted except with the prior written consent of the professor or if part of an approved accommodation plan.

Labs

- You must stick to your assigned lab unless you have a particular reason for changing labs in a given week; any change must be approved in advance by your TA.
- There are gaps in the lab schedule for both the Monday and the Tuesday lab to deal with holidays and other special events. Do not assume that your other classes will have the same lab schedule.
- Labs will start in ESB 4-09 but for parts of some labs you will break out into ESB 1-39 for computer work. We may need to schedule computer time so that everyone gets a turn on the available machines.
- **No personal entertainment devices with headphones.** Often we explain something to everyone in the class, even if one person asked a question. We should not be competing for your attention.
- **Computers:** use no programs other than those directly related to structural geology. Web surfing or reading email is disrespectful to your instructor and TA, and is not an appropriate use of the resource.
- For each lab you should have the following available:
 - Tracing paper, graph paper, a ruler at **least 30 cm long** (11.81 inches)
 - A calculator with scientific functions. Do not use your phone as a calculator as you are not allowed to bring it to tests and exams.
 - Lead pencils that are sharp and **can be kept sharp** (old fashioned pencils and a sharpener, or mechanical pencils with 0.5 mm leads).
 - A good eraser.
 - Some coloured pencils ('pencil crayons'). Please note that these are useful for labelling structures in diagrams but must never be used for accurate constructions!
 - Your onecard

Resources

Required Textbook: *Structural Geology* by Haakon Fossen

This valuable text allows you to review most types of structure found in the Earth's lithosphere, and includes review material for the major topics covered in the introductory class EAS 233.

Additional readings: *Plate Tectonics* by Frisch, Meschede & Blakely

This textbook covers two topics that are not covered in detail in the main textbook. It is available as an electronic resource through the University Library

Recommended or Optional Learning Resources:

Notes and links will be posted during the course at <http://courses.eas.ualberta.ca/eas421>

In addition to the text, you may also find that the **laboratory manual for EAS 233** contains useful reference material. Copies of this manual, together with copyrighted materials that can't be posted on a public web site, will be posted at eclass: <https://eclass.srv.ualberta.ca/> where you will have to sign in with your university CCID and password. Marks will also be posted using eclass.

Evaluation and grading

Grade Evaluation:

Grade evaluation will be by a combination of relative standing in the class and absolute achievement. This means that each assignment and test will be assigned a numerical mark and those marks will be summed using the weighting below. A final grade will be assigned based on the overall quality of the work done and where possible on natural breaks in the grade distribution, so as to be consistent in standard with previous years' grading. No absolute grade distribution ('curve') will be imposed on the grades, but the overall level and range of grades is likely to be similar to other classes at this level at the University of Alberta, in which the mean grade is typically in the B to B+ range.

Grades are unofficial until approved by the Department and/or Faculty offering the course.

COMPONENT	WEIGHTING	DATE
Midterm test	10%	October 2, Friday, 10 am
Midterm test	10%	November 2, Monday, 10 am
Lab assignments	36%	Weekly
Final Exam*	44%	December 15, Tuesday, 9 am

* WARNING: Students must verify this date on Bear Tracks when the Final Exam Schedule is posted

Format of Exams:

Exams will combine theoretical and practical aspects of the course, and will include a mixture of short-answer, longer written answer, and practical questions. Questions in the mid-term test will cover fundamental techniques; you will be asked to answer all the questions. The final exam will contain a mixture of practical and theoretical questions and will include both a compulsory section and a choice of questions.

Exam coverage will be cumulative: In other words you can't forget material covered early in the course when you take later sections! On the other hand, we aim to make all parts of the course contribute equally to the final grade, so the final exam will have slightly less emphasis on parts of the course that have previously been tested.

Requirements for exams: Your student photo I.D. is required at exams to verify your identity. You will not be allowed to begin an examination after it has been in progress for 30 minutes. You must remain in the exam room until at least 30 minutes have elapsed. Electronic equipment other than calculators cannot be brought into examination rooms and hats should not be worn.

Bring to the exam room all the materials you normally bring to the labs. **Before you enter the exam room**, please stow all textbooks, notes, and review materials securely inside a bag, and get out all the pens, pencils, etc. that you plan to use. **You are not permitted to look through your bag in the exam room.**

Sample questions

Sample questions from previous tests will be posted on the class web site in advance of tests. These are to indicate the formats and types of question to be asked in the tests.

Note that these are not called "practice questions" because the questions on the actual tests will mostly be new; they may ask you to make connections between the ideas you have learned in new and possibly unexpected ways. If your pre-exam review covers only this sample material you will be doing only questions that are not likely to be on the actual test!

Academic Integrity

EAS 421 is a very practical course in which you may benefit from discussions with your instructor, teaching assistants, and fellow students in devising problem-solving strategies. However, the actual answers you record must be exclusively your own work. This means that:

- observations must be your own;
- written answers must be expressed in sentences and paragraphs **composed uniquely in your own words**;
- every calculation and construction **must be carried out by you**.
- every diagram must be **designed and drawn by you**.
- If you are explicitly instructed to work in groups on a problem, your answer must contain a clear written acknowledgement of the other participants and a statement of who did what.

The University of Alberta is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Code of Student Behaviour, online at www.ualberta.ca/secretariat/appeals.htm, and avoid any behaviour which could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.

*All forms of dishonesty are unacceptable at the University. Any offense will be reported to the Senior Associate Dean of Science who will determine the disciplinary action to be taken. Cheating, plagiarism and misrepresentation of facts are serious offenses. Anyone who engages in these practices will receive **at minimum** a grade of zero for the exam or paper in question and no opportunity will be given to replace the grade or redistribute the weights. As well, in the Faculty of Science the sanction for **cheating** on any examination will include **a disciplinary failing grade** (no exceptions) and senior students should expect a period of suspension or expulsion from the University of Alberta.*

Cell phones: *Cell phones are to be turned off during lectures, labs and seminars. Cell phones are not to be brought to exams.*

Deferrals, reexaminations: *Misrepresentation of Facts to gain a deferral of an assignment, test, or examination or a reexamination is a serious breach of the Code of Student Behaviour.*

Student Responsibilities and support:

Missed Term Exams and Assignments:

You are required to attend your assigned lab section. However, if you are unable to do your lab at the assigned time for any of the reasons outlined below, please contact **your TA**. If you are unable to attend a mid-term test for any of the reasons outlined below, please contact the **instructor** for the course.

A student who cannot write a term examination or complete a term assignment due to incapacitating illness, severe domestic affliction or other compelling reasons can apply for extension of time to complete an assignment or deferral of the midterm weight to the final examination. If you are in this situation at the time of a lab or examination, please be sure to contact your instructor within 48 hours of the missed class. Deferral of term work is a privilege and not a right; there is no guarantee that a deferral will be granted. Please note that illness in the days before an exam is not normally considered to be grounds for deferral; don't leave your study to the last minute!

Deferred Final Examination:

A student who cannot write the final examination due to incapacitating illness, severe domestic affliction or other compelling reasons can apply for a deferred final examination. Such an application must be made to the **student's Faculty office** within 48 hours of the missed examination. Deferred examinations are a privilege and not a right; there is no guarantee that a deferred examination will be granted.

Reexamination:

A student who writes the final examination and fails the course may apply for a reexamination. Reexaminations are rarely granted in the Faculty of Science. These exams are governed by University (Calendar section 23.5.5) and Faculty of Science Regulations (Calendar section 182.5.9).

Students with disabilities:

Students who require accommodation in this course due to a disability are advised to discuss their needs with Student Accessibility Services (2-800 Students' Union Building).

Academic support centre:

Students who require additional help in developing strategies for better time management, study skills or examination skills should contact the Academic Support Centre (2-703 Students' Union Building).

Legalities

Copyright: This document, and other documents distributed during the course (except where otherwise stated), are copyright © Dr. John Waldron, Department of Earth and Atmospheric Sciences, Faculty of Science, University of Alberta (2015), and may not be sold or reproduced without permission.

Disclaimer: Any typographical errors in this Course Outline are subject to change and will be announced in class. The date of the final examination is set by the Registrar and takes precedence over the final examination date reported in this syllabus.

EAS 421 & 521, Fall 2015, Provisional Schedule

Dates	Lecture	Dates		Lab
Sep 02, Wed	Introduction		Sep 02, Wed	
Sep 04, Fri	Orientation data			
Sep 07, Mon		Sep 07, Mon	Sep 08, Tue	
Sep 09, Wed			Sep 09, Wed	0 521:Poster Introduction
Sep 11, Fri				
Sep 14, Mon	Plate kinematics	Sep 14, Mon	Sep 15, Tue	0 421: Optional preliminary lab
Sep 16, Wed			Sep 16, Wed	0 521: Preliminary lab
Sep 18, Fri				
Sep 21, Mon		Sep 21, Mon	Sep 22, Tue	1 Orientation data
Sep 23, Wed	Stress		Sep 23, Wed	1 Orientation data
Sep 25, Fri				
Sep 28, Mon		Sep 28, Mon	Sep 29, Tue	2 Plate kinematics
Sep 30, Wed			Sep 30, Wed	2 Plate kinematics
Oct 02, Fri	Mid-term test			
Oct 05, Mon	Rifts and extension	Oct 05, Mon	Oct 06, Tue	3 Lithosphere deformation
Oct 07, Wed			Oct 07, Wed	3 Lithosphere deformation
Oct 09, Fri				
Oct 12, Mon		Oct 12, Mon	Oct 13, Tue	
Oct 14, Wed	Deformation and Strain		Oct 14, Wed	521:Poster review
Oct 16, Fri				
Oct 19, Mon		Oct 19, Mon	Oct 20, Tue	4 Stress
Oct 21, Wed			Oct 21, Wed	4 Stress
Oct 23, Fri	Orogens: introduction			
Oct 26, Mon	Fold & thrust belts	Oct 26, Mon	Oct 27, Tue	5 Rifts
Oct 28, Wed			Oct 28, Wed	5 Rifts
Oct 30, Fri				
Nov 02, Mon	Mid-term test	Nov 02, Mon	Nov 03, Tue	6 Strain measurement
Nov 04, Wed			Nov 04, Wed	6 Strain measurement
Nov 06, Fri	Subduction zones			
Nov 09, Mon	Reading week			
Nov 11, Wed				
Nov 13, Fri				
Nov 16, Mon	Metamorphic belts	Nov 16, Mon	Nov 17, Tue	7 Thrust belts
Nov 18, Wed			Nov 18, Wed	7 Thrust belts
Nov 20, Fri				
Nov 23, Mon	Progressive strain	Nov 23, Mon	Nov 24, Tue	8 421: Metamorphic belts
Nov 25, Wed			Nov 25, Wed	521: Poster presentations
Nov 27, Fri	Rheology and shear zones			
Nov 30, Mon		Nov 30, Mon	Dec 01, Tue	9 421: Ductile Shear zones
Dec 02, Wed			Dec 02, Wed	521: Poster presentations
Dec 04, Fri	Strike-slip			
Dec 07, Mon		Dec 07, Mon		
Dec 15, Tue	9 am Final Exam (3 hrs)			