

Structural Geology & Tectonics

Instructor

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<http://www.depauw.edu/academics/departments-programs/geosciences/>

Class (Julian 223)

10:30-11:30 am MWF

8:00-9:50 am Th (LAB)

Office Hours

8:30-9:30 am MWF

other times: stop in or by appt.

Texts

Structural Geology, Fossen,
(Cambridge, 2011).

Basic Methods of Structural Geology
Marshak & Mitra, (Prentice-Hall, 1988).

A pencil (0.5mm, 2H or 2), an eraser,
a scientific calculator, a small stapler, & a USB flash drive will
be needed for this course. Colored pencils, a pen, and a
C-Thru™ 6" ruler/protractor combo* would be useful.

**The Department has some available at cost.*



COURSE GOALS

To use observations, measurements, and the logic of science to gain an understanding of the geometric (shape), kinematic (motion) and dynamic (mechanical) development of structural features that form the architectural framework of the Earth. Upon completion of this course, you should leave with a detailed understanding of..

- the different types of structures formed in nature. Besides rock type, the most commonly observed feature in outcrops are primary sedimentary structures (e.g., bedding, cross-bedding) or tectonic structures (e.g., fractures, faults, folds). Students should be able to readily identify these features.
- the processes of how basic structures form and evolve (both kinematically and mechanically)
- the influence of various factors (e.g., lithology, temperature, pressure, stress) on the deformation (i.e., strain) of rock bodies.
- the linkage between structural geology (at all scales) to tectonics. You will learn to make observations at the micro- and meso-scale and extrapolate those observations to larger features.

Structural processes have a profound effect on society: earthquakes (faults), hydrocarbon entrapment (folds) & seals (faults), water & contaminant flow (fractures/faults), engineering for construction projects & mining (rock strength), map & cross-section construction/interpretation (various fields), etc.

This syllabus is meant to provide an outline for the general flow of the course. At my discretion, I will add or omit topics and/or modify the timetable.

COURSE ORGANIZATION

Lectures typically will consist of computer-based lectures supplemented by animations, whiteboard drawings, demonstrations, websites, *Google Earth* activities, etc. It is a good idea to take detailed notes as I provide more information than is provided on the projected lecture slides. Also, because the book and I may choose to focus on different aspects of a given topic, it is important that you stay current on both the lecture material and the textbook readings. Please come to class having read and having thought about the readings. Please ask questions about any material (lecture or textbook) that you need clarified.

Please refrain from using cell phones and laptops during class time except for activities directly related to our course (as specified by your instructor or in cases of emergencies). If you are tempted to use electronic devices for non-academic purposes during class, it probably is best to turn off the device and leave it in your backpack during class.

The Marshak & Mitra text will be the basis for many of our lab assignments, some of which will use personal productivity software, specialized geology software, and the Internet (you may use the Mac Lab

in Julian 201). Lab assignments typically are due at the beginning of the next week's lab unless specified otherwise.

We most likely will have one 'lab' field trip to Baraboo, WI this semester. Please check with your other instructors ASAP to determine if there are any conflicts with the Baraboo trip (if these cannot be resolved, we'll have to work out an alternative assignment). The Department will provide transportation and lodging, however each student will be responsible for his/her own food.



GRADES

The basis for final grades is described in the table below. All materials to be turned in for a grade must be clearly written (or typed) and stapled. Late assignments will not be accepted and will receive a "0". Make-up exams/quizzes/ assignments will not be given unless there is a documented emergency or unless we have arranged a make-up in advance because of exceptional circumstances.



Percent of Final Grade		Grading Scale*	
Lecture Exam 1	25%	A	100-93%
Lecture Exam 2	25%	A-	92-90%
Lecture Exam 3	25%	B+	89-87%
Assignments/Projects/Quizzes	25%	B	86-83%
		B-	82-80%
		C+	79-77%
		C	76-73%
		C-	72-70%
		D+	69-67%
		D	66-63%
D-	62-60%		
		F	<60%

**Numeric scores rounded up from 0.50. I reserve the right to adjust the grading scale up slightly (benefitting you!), if warranted by the class grade distribution.*

ATTENDANCE

Regular and on-time attendance is expected and monitored (see the Student Handbook for the University policy on attendance). It has been my experience that learning comprehension improves when students listen to lectures, ask questions, and discuss the material in the classroom setting as opposed to just reading the notes and/or textbook. In addition, some activities (e.g., labs) require attendance to receive credit. The best policy is to attend class on a regular basis, and should you know that you will be absent (e.g., health issue regarding yourself or immediate family, athletic obligation, etc), please contact me in advance to make arrangements about assignments.

Academic Integrity:

Any attempt to gain an unfair advantage over other students in the class will be handled in accordance with established University procedures as described in the Academic Handbook section on Academic Dishonesty:

<http://www.depauw.edu/handbooks/academic/policies/integrity/>

Writing Center Information on Plagiarism:

<http://www.depauw.edu/academics/academic-resources/academic-resource-center/w-center/w-center-handouts/>

KEYS TO SUCCESS IN THIS COURSE:

- 1. Read the Books** in a distraction-free environment and in advance of lecture over that material. As you're reading, carefully note any questions that you have.
- 2. Ask Questions.** The only stupid question is one that is unasked. It is essential to ask questions to clarify any concepts that you do not understand. PLEASE do not be too shy, embarrassed, intimidated, afraid, etc. to ask questions.
- 3. Take Good Notes.** Students with complete notes seem to do better in class. Try to write down the key material from the lecture and include as many sketches as possible. Rewriting your notes will make them more legible and orderly, plus it will help you focus on areas that are still unclear. Be careful of falling into "TV-watching mode", as it is easy to look at the pictures and not take down any notes.
- 4. Know the Key Terms** (these are brown in the chapter text). If I use a term that you don't understand, PLEASE ASK me to define it.
- 5. Use the Glossary** in the back of the book to help understand key terms.
- 6. Check out the Internet.** You can use a search engine to find web sites that relate to topics that we are currently studying. We also may be using Google Earth (<http://earth.google.com>) throughout the semester.
- 7. Answer the Review Questions/Work through the E-Learning Materials.** Answers to the review questions and the e-learning modules are available at: <http://www.cambridge.org/fossen> or <http://folk.uib.no/ngl/he/StructuralGeoBook.html> (including book errors).
- 8. Use the library.** There are many books & articles in the library that pertain to the topics we will be discussing (e.g., other structural geology & tectonics textbooks, introductory geology textbooks, etc.). Also, we have a great interlibrary loan system for materials that our library does not carry.
- 9. Create your own Study Aids.** Some people like to highlight text in the chapter, others like to make flash cards, and still others like to study in groups and discuss the material. Feel free to experiment with what works for you. In addition, the Academic Resource Center in Asbury Hall (1st floor) has tutors and trained people available to help you refine and improve your study habits and techniques.
- 10. Study the Material on a Regular Basis.** It is important that everyone maintain good study habits by regularly working with the assigned material. Procrastination and cramming just don't work for most of us...it is best to get comfortable with the material as we go along so that you don't fall behind.
- 11. Study for the Exam** as an Individual and then as a Group. Again, different people study in different ways. I've found that it helps to study as an individual first (thinking about what important concepts were emphasized in each chapter & lecture), then get together with others and study as a group (e.g., asking each other questions, brainstorming about what will be on the test, etc.).



ORDER OF TOPICS

Week Starting	Lecture (Fossen) <i>(Last Day to Withdraw 3/22)</i>	Lab (M&M)
1: 1/28	Syllabus/Course Organization Nature of Structural Geology (<i>Fossen Ch 1</i>) Primary Structures	Attitudes of Planes & Lines (<i>M&M Chap 1</i>)
Part I-Mechanics		
2: 2/4	Strain (<i>Fossen Ch 2-3</i>)	Strain (<i>M&M Chap 15</i>)
3: 2/11	Stress (<i>Fossen Ch 4-5</i>)	Strain (<i>M&M Chap 15</i>)
4: 2/18	Rheology (<i>Fossen Ch 6</i>)	Stereonets (<i>M&M Ch 5, 6, & 8</i>)
5: 2/25	Brittle Failure (<i>Fossen Ch 7</i>) Exam #1 - 03/01/2012 (est)	Intro to Maps (<i>M&M Ch 2-3 & Wilk Ch 7</i>)
Part II-Structures		
6: 3/4	Fractures & Veins (<i>Fossen Ch 7</i>)	Intro to Maps (<i>M&M Ch 2-3 & Wilk Ch 7</i>)
7: 3/11	Faults (<i>Fossen Ch 8-9</i>)	Cross Sections (<i>M&M Ch 13-14; Fossen Ch 20</i>)
8: 3/18	Folds (<i>Fossen Ch 11</i>)	Cross Sections (<i>M&M Ch 13-14; Fossen Ch 20</i>)
9: 3/25	Spring Break	
10: 4/1	Foliations/Lineations (<i>Fossen Ch 12-13</i>) Ductile Shear Zones (<i>Fossen Ch 14-15</i>)	Cross Sections (<i>M&M Ch 13-14; Fossen Ch 20</i>)
Part III-Structural Families in Tectonic Settings		
11: 4/8	Exam #2 - 04/12/2012 (est) Contractional Tectonics (<i>Fossen Ch 16</i>)	Geologic Maps (<i>M&M Ch 9 & Wilk Ch 8</i>)
12: 4/15	Fold-Thrust Belts (<i>Fossen Ch 16</i>)	Geologic Maps (<i>M&M Ch 9 & Wilk Ch 8</i>)
13: 4/22	Ext Tectonics (<i>Fossen Ch 17</i>)	Seismic Interpretation
14: 4/29	Strike-Slip Tectonics (<i>Fossen Ch 18</i>)	Baraboo, WI Field Trip (Brunton-M&M 1) <i>Depart Fri 5/3 @12 pm</i> <i>Return Sun 5/5 @ ~5 pm</i>
15: 5/6	Salt Tectonics (<i>Fossen Ch 19</i>)	Seismic Interpretation
Exam #3: SAT, May 11, 2013 8:30- 11:30 am, Rm 223 Julian		
Note: These topics and exam times are subject to change.		
We will need a few students (21+ years old) to become certified for driving University vehicles in order to go on field trips. Please visit http://www.depauw.edu/studentlife/campus-safety/publicsafety/education-and-awareness/drivers-safety/ to find out about driver certification classes.		

FAQ:

Are lecture notes from the slides provided? PDF's of the lecture notes are available on the class Moodle site. Please note that I will initially post notes from the last time the course was offered, (2012 prefix) but that I will post any revised PDF's of the lecture notes before the next corresponding exam (2013 prefix).

Should we copy all the text on the slides? There shouldn't be a need with access to PDF's of the lecture notes (it might be useful to bring printouts to class so that you can annotate them). It is far better to listen to me and take notes than to copy the slides. Sometimes text on slides is really just to trigger me on a topic and not something to be committed to your notes. In addition, I commonly go more in-depth than what is on the slides, and you will be responsible to know that detail for the exams.

Can we have an exam review sheet? I prefer to highlight topics as a preface for each slide set with a "Some Key Things to Know..." slide, so that you are aware of important topics prior to me going over them. In addition, we usually arrange a time prior to an exam to conduct an oral Q&A review to clarify geoscience concepts.

