

Structural Geology & Tectonics

Instructor

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

Class (Julian 226)

9:10-10:10 am MWF

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

Office Hours

2:45-3:45 pm MWF

other times: stop in or by appt.

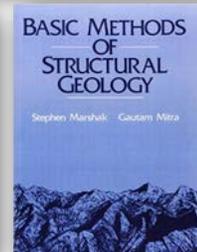
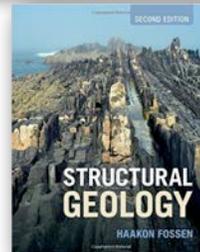
Texts

Structural Geology, Fossen, 2nd ed., (Cambridge, 2016).

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.



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.

DESCRIPTION

This course employs a variety of teaching approaches to maximize student learning of geoscience content in a classroom where different students optimally learn material in different ways. Specifically, this course will involve mostly Apple Keynote computer-based lectures, supplemented with experiments/demonstrations, applied projects/labs/homework sets, field trip(s), etc. We also may be using various computer software packages to facilitate our learning, including Adobe Illustrator, Google Earth, and various discipline-specific programs.

I provide my slides as PDFs on Moodle, so that students can print them out before class and annotate them with detailed notes during class (as I commonly provide more information than is provided on the projected lecture slides). That way, students aren't scrambling to write down every single word on a slide, allowing them to focus on the content and to participate in the discussion. To facilitate discussion (and because the book and I may choose to focus on different aspects of a given topic), students must "R&R" the textbook and the lecture slides before class (no, this is not "rest & relaxation", but rather

"read & retain"). Please ask questions about any material (lecture or textbook) that you need clarified.

The distinction between "lecture" and "lab" may become blurred throughout the semester (in terms of both content and class times). The Marshak & Mitra text will be the basis for some of our assignments, and will provide an excellent reference for many of the techniques that we will be discussing. Assignments may not be turned in for a grade, but the material will be addressed on lecture/lab exams. The Geoscience Computational Laboratory (Julian 201) should be open from ~8:00 am-5:00 pm weekdays (except when classes are being conducted in the room) to work on your assignments/projects.

We will have at least one 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 turned in on time, clearly written (or typed), and stapled in order. Work that fails to meet these criteria will not be accepted and will receive a "0". Make-up exams/quizzes will not be given unless there is a documented emergency or unless we have arranged a make-up in advance because of exceptional circumstances. Quizzes may be announced/unannounced and may cover material from assigned readings, "lecture", and/or "lab" (*I also may have you turn in some labs/homework for a quiz grade to show that you worked the problems, but not for an explicit check of your answer(s)*). The lowest quiz score will be dropped.

Participation. Participation/engagement grades for this course will be based on a "standard" - "sub-standard" system. Everyone starts out with a "standard" grade, and I expect that most of you will finish the semester with this grade. A "standard" grade means you are attending class consistently, and you are participating in a reasonable way during most class sessions. If I judge your participation to be falling into the "sub-standard" range (e.g., excessive absences/tardiness, consistent lack of preparation or participation in activities, electronic distraction, sleeping/lack of attention, frequently getting up in class, etc.), I will explain the issue to you without penalty and will work with you to develop a plan for improvement. If an issue persists, I will explain the issue again and will assign a sub-standard participation grade. Each such sub-standard grade will result in lowering your final course grade by one percentage point.

Percent of Final Grade		Grading Scale*	
Lecture Exam 1	20%	88%	100% = A- to A
Lecture Exam 2	20%	77%	87% = B- to B+
Lecture Exam 3	20%	66%	76% = C- to C+
Lab Exam	20%	55%	65% = D- to D+
Quizzes and/or Projects/Assignments (the lowest quiz score will be dropped)	20%	00%	54% = F

KEYS TO SUCCESS IN THIS COURSE

1. **Read the Assigned Material** in a distraction-free environment and in advance of lecture over that material. As you are reading, carefully note any questions that you have.
2. **Take Good Notes.** Students with complete notes seem to do better in class. If possible, print out the lecture slides before class and annotate them from the lecture/discussion (including sketches from the whiteboard). 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.
3. **Ask Questions.** The only "bad" question is one that is unasked. It is essential to ask questions to clarify any concepts that you do not understand. *If I forget to call on you while I am in the middle of explaining something in lecture, PLEASE raise your hand again to remind me as I most certainly want to answer your questions!*
4. **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/nglhe/StructuralGeoBook2ndEd.html> (including book errors).
5. **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.
6. **Use the Glossary** in the back of the book to help understand key terms.
7. **Check out the Internet.** There is a world of information on structural geology/tectonics out on the Web (you might use a search engine to find web sites of interest). We also may use Google Earth Pro (<http://earth.google.com>) throughout the semester (key code = GEPFREE).
8. **Use the library.** There are many books & articles in the library that pertain to the topics that we will be discussing (see <http://libguides.depauw.edu/geosciences>; we have a great interlibrary loan system for other 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 Q 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.).

**Feedback:**

I usually need at minimum of a week to return work. While I might not always write detailed explanations on graded work, I will orally go over the answers or work the problems in class (usually based on student requests). Please ask questions in class or stop by my office if a concept is not clear or if you have a question on how I graded your work.

Additionally, you need to give me feedback about how the course is going. It is important that you "rein me in" if I go too fast or if I haven't explained something well enough. **Ask questions!!!**

TENTATIVE ORDER OF TOPICS

Week Starting	Lecture (Fossen) <i>last day to withdraw - 03/24</i>	Lab (M&M)
01: 01/30	Syllabus/Course Organization Nature of Structural Geology (<i>Fossen Ch 1</i>) Primary Structures	Attitudes of Planes & Lines (<i>M&M Ch 1</i>)
Part I-Mechanics		
02: 02/06	Strain (<i>Fossen Ch 2-3</i>)	Strain (<i>M&M Ch 15</i>)
03: 02/13	Stress (<i>Fossen Ch 4-5</i>)	Strain (<i>M&M Ch 15</i>)
04: 02/20	Rheology (<i>Fossen Ch 6</i>)	Stress (<i>M&M Ch 10</i>)
05: 02/27	Brittle Failure (<i>Fossen Ch 7</i>)	Stereonets (<i>M&M Ch 5, 6, & 8</i>)
Part II-Structures		
06: 03/06	Exam #1 - 03/08/2017 (est) Using a Brunton Compass (<i>M&M 1</i>)	Stereonets (<i>M&M Ch 5, 6, & 8</i>)
07: 03/13	Fractures & Veins (<i>Fossen Ch 8</i>)	Fracture Mapping-Cagles Mill (<i>M&M Ch 2-3 & Wilk Ch 7</i>)
08: 03/20	Faults (<i>Fossen Ch 9-10</i>)	Contour Map Analysis (<i>M&M Ch 2-3 & Wilk Ch 7</i>)
09: 03/27	Spring Break (03/25-04/02)	
10: 04/03	Folds (<i>Fossen Ch 12</i>)	Geologic Maps (<i>M&M Ch 9 & Wilk Ch 8</i>)
11: 04/10	Foliations/Lineations (<i>Fossen Ch 13-14</i>) Ductile Shear Zones (<i>Fossen Ch 15-16</i>)	Geologic Maps (<i>M&M Ch 9 & Wilk Ch 8</i>)
Part III-Structural Families in Tectonic Settings		
12: 04/17	Exam #2 - 04/19/2017 (est) Contractional Tectonics (<i>Fossen Ch 17</i>)	Baraboo, WI Field Trip (<i>Brunton-M&M 1</i>) Depart Fri 4/21 or 05/05 @12 pm Return Sun 4/23 or 05/07 @ ~5 pm
13: 04/24	Fold-Thrust Belts (<i>Fossen Ch 17</i>)	Cross Sections (<i>M&M Ch 13-14; Fossen Ch 21</i>)
14: 05/01	Ext Tectonics (<i>Fossen Ch 18</i>)	Cross Sections (<i>M&M Ch 13-14; Fossen Ch 21</i>)
15: 05/08	Strike-Slip Tectonics (<i>Fossen Ch 19</i>) Salt Tectonics (<i>Fossen Ch 20</i>)	Lab Exam <i>Attitudes, Using a Brunton Compass, Stereonets (folds/rotations/paleocurrent), Baraboo Field Trip, Map Analysis/Interpretation & Cross Sections</i>
Exam #3: MON, May 15, 2017 8:30- 11:30 am, Julian 226		
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 will be available in Moodle. Please bring printouts to class, so that you can annotate them. Please note that if I post notes from the last time the course was offered, I will post any revised PDF's of the lecture notes before the next corresponding exam.

Should we copy all the text on the slides? There shouldn't be a need with access to PDF's of the lecture notes. However, it is *far better* to listen to me/our discussion 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 want to learn that detail.

Can we have an exam review sheet? I always do oral Q&A reviews before every exam to clarify geoscience concepts.

Policy Page

ADA STATEMENT

It is the policy and practice of DePauw University to provide reasonable accommodations for students with properly documented disabilities. Written notification from Student Disability Services is required. If you are eligible to receive an accommodation and would like to request it for this course, please contact Student Disability Services. Allow one week advance notice to ensure enough time for reasonable accommodations to be made. Otherwise, it is not guaranteed that the accommodation can be provided on a timely basis. Accommodations are not retroactive. Students who have questions about Student Disability Services or who have, or think they may have, a disability (psychiatric, attentional, learning, vision, hearing, physical, medical, etc.) are invited to contact Student Disability Services for a confidential discussion in Union Building Suite 200 or by phone at 658-6267.

ATTENDANCE

Regular and on-time attendance is expected and monitored (see the Student Handbook <http://www.depauw.edu/handbooks/academic/policies/attendance/>). As stated in the Student Handbook, excessive absences can be grounds for being dismissed from the course. In addition, it has been my experience that learning comprehension improves dramatically when students are present to listen to lectures, to ask questions, and to discuss the material in the classroom setting. In addition, some activities (e.g., field work) require attendance to receive credit. 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 (or ASAP afterwards) 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 Integrity: <http://www.depauw.edu/handbooks/academic/policies/integrity/>

DePauw Academic Resources on Academic Integrity
<http://www.depauw.edu/academics/academic-resources/academic-integrity/>

Writing Center Information on Plagiarism:
<http://www.depauw.edu/academics/academic-resources/academic-resource-center/w-center/w-center-handouts/>

CELL PHONE/COMPUTER/SMART DEVICE USE

Before class begins, turn off your cell phone (or set it to vibrate) and put it away (face down on top of the table or in your backpack...not in the table or on your person). Do not check or send voicemail or text messages during class, and do not leave class to check or send messages unless 1) you have an emergency (inform your instructor prior to class starting of special circumstances involving a personal emergency situation that would require you to use your phone when class is in session) or 2) are on an instructor-designated break. In other words, do not use your cell phone in class for any reason at any time unless you have consulted with the course instructor. I will have my cell phone on in the case of a campus emergency.

If you have a cell phone/smartwatch on your person or on your desk/table during an exam without the instructor's permission, you will receive a 0 on the exam, and you will automatically be considered in violation of DePauw's academic integrity policy on cheating due to unauthorized use of a cell phone/smartwatch. You may not take your cell phone/smartwatch with you on bathroom breaks during exams.

Please read the following: <http://www.insidehighered.com/blogs/just-visiting/open-letter-incoming-freshmen>

Laptops, tablets, smartwatches, and other electronic devices are not allowed to be used in the classroom except for activities directly related to our course as specified by your instructor (e.g., do not check or send emails, chats, or texts, do not use your web browser except for course-sanctioned activities, etc.). Quit all programs not specifically designated by your instructor (not only reducing temptation, but also helping your computer run more efficiently).

Violating the cell phone/computer/smart device use policy is one way students may be considered not engaged/participating in course activities (see the Grades discussion on participation above).

Policy Page

CLASSROOM BEHAVIOR

- **Early is on time, and on time is late.** (especially on days with field activities).
- **Respect everyone.** (yourself, your peers, and your instructor).
- **Listen and contribute.** Lecture and discussion portions of our class can quickly morph to lecture only if you are not an active and contributing participant in class.
- **Work to the best of your ability.** True learning is hard work and is constructed and nurtured by you (not simply transferred from the instructor). A strong work ethic will not only serve you well in this course, but in life in general. Do not settle for less than your best effort.
- **Be aware of consequences (positive & negative).** If you make good decisions (e.g., reading the course materials, taking notes, asking questions, working hard, etc.), you will likely experience good consequences such as enhanced understanding of geoscience processes, improved grades, and general success in life. Conversely, poor decisions (e.g., waiting to cram right before an exam or assignment, pulling an “all-nighter” and coming to class exhausted, relying on energy drinks or other substances, distracting yourself or others with cell phones or laptops, etc.) typically have negative consequences that cause your understanding of course content to suffer.
- **Consider the classroom your workplace.** Once you step inside the classroom, commit yourself to learning as much as you can during that time. Do not routinely get up during class to take care of personal needs (e.g., bathroom breaks, social networking, etc.). Please address these needs during the break between classes. If an emergency occurs, please feel free to leave the classroom to address it.

AUDIO/VISUAL POLICY

- No video, audio, or still picture recordings are allowed during class without the instructor's permission.
- No video recordings, still picture, or other means of duplication (e.g., xeroxing) of homework assignments, labs, exams, etc. are allowed without the instructor's permission.
- ADA accommodations pertaining to recordings of lectures for taking notes are typically addressed by the instructor providing handouts of lecture slides/materials.

