Structural Geology & Tectonics

Instructor
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mswilke@depauw.edu
http://www.depauw.edu/academics/departments-programs/geosciences/

Class (Julian 223)
1:40-2:40 pm MWF
1:40-3:30 pm Th (LAB)

Office Hours
Stop in or by appointment.

Texts
Basic Methods of Structural Geology

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 that 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 Apple Keynote computer-based lectures supplemented by animations, whiteboard drawings, Google Earth activities, websites, etc. Please take detailed notes as I provide much more information than is provided on the projected lecture slides. Please ask questions about any material that you need clarified. Quizzes & homeworks also may occur periodically throughout the semester.

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). Labs will be due the following week at the beginning of lab, unless I specify otherwise. E-learning modules are available at: http://www.cambridge.org/fosse or http://folk.uib.no/nglhe/StructuralGeoBook.html (includes book errors).

We 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. If there is student interest and time, we also may consider having an additional field trip to another location.

Cell phones should not be used during class (i.e., no text messaging; you may certainly answer emergency calls). Laptops should be used for classroom purposes only (not to surf the Internet, chat with friends, or check email). Using a laptop to take notes generally doesn’t work well in this class as it is important for you to also construct annotated drawings of key figures. You may use laptops to do Google Earth activities.

GRADS

Final grades will be based on the assignments/activities shown in the table below. All materials to be turned in for a grade must be clearly written/typed and stapled; late/messy/unstapled assignments will not be accepted and will receive a "0". Extensions/makeups will not be given unless there is a documented emergency or unless we have arranged an extension in advance because of exceptional circumstances. Exams will cover material from lectures, selected labs, homeworks, and selected sections of the book (exams tend to be applied in nature, and as such, may include calculations, essay/sketch questions, descriptions of structural features from photos/hand samples, etc.). The participation/effort grade is entirely subjective and will not be open for debate.

Note that grades are based on a weighted average, not a straight average based on points. I calculate your grades automatically and can provide you up-to-date information on your grades at any time. It is important not to wait until the last month of class to become concerned about your grade.

<table>
<thead>
<tr>
<th>Percent of Final Grade</th>
<th>Grading Scale</th>
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<tbody>
<tr>
<td>Exam #1</td>
<td>21.0%</td>
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<tr>
<td>Exam #2</td>
<td>21.0%</td>
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<td>Exam #3</td>
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<tr>
<td>Labs/Assignments/Quizzes</td>
<td>34.0%</td>
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<tr>
<td>Participation/Effort</td>
<td>3.0%</td>
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Grading Scale:

A >90%
B 80-89%
C 70-79%
D 60-69%
F <60%

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

Academic Handbook section on Academic Dishonesty: http://www.depauw.edu/handbooks/academic/policies/integrity/

Note: From the section on Types of Academic Dishonesty, “Students are responsible for knowing the academic integrity policy and may not use ignorance of the policy as an excuse for dishonesty.”

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

ATTENDANCE

Attendance (and participation) is required and will be monitored.

Excused Absences
Should you know that you will be absent (e.g., health issue regarding yourself or immediate family, athletic obligation, etc.), please contact me BEFORE class to make arrangements about assignments/exams/field activities. If you are ill, please do not come to class (wait until you are without a fever for 24 hrs without medication). Unexcused absences will not be allowed to makeup missed materials.

Excessive Absences
Should you miss more than 6 class sessions (for any reason, excused or unexcused), you can (and likely will) be dropped from the course in accordance with procedures described in the Academic Handbook (unless there is an exceptional, well-documented reason not to do so, as determined in consultation with the Office of Academic Affairs).

Academic Handbook section on Attendance:
http://www.depauw.edu/handbooks/academic/policies/attendance/

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. Refer to other related books in the library or your physical geology text to clarify or to refresh your memory regarding the material to be covered.

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. E-learning modules for the text are available at: http://folk.uib.no/nglhe/Emodules.html.

7. Use the library. There are many books & articles in the library that pertain to the topics we will be discussing…use them. Also, we have a great interlibrary loan system for materials that our library does not carry. Also, you will find introductory geology textbooks in the library, which will provide helpful information about geologic features and processes.

8. 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.

9. 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.

10. 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 (perhaps longer for exams/large assignments). I try to write detailed comments on the papers that I return to you. I will “go over” all exams with you and homeworks as needed. 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!!!
ORDER OF TOPICS

<table>
<thead>
<tr>
<th>Week Starting</th>
<th>Lecture (Fossen) (Last Day to Withdraw 3/23)</th>
<th>Lab (M&amp;M)</th>
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<tbody>
<tr>
<td>1: 1/30</td>
<td>Syllabus/Course Organization</td>
<td>Structural Geology &amp; Tectonics using Google Earth (Geotours PDF)</td>
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<td>Nature of Structural Geology (Fossen Ch 1)</td>
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<td>Primary Structures</td>
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<td>2: 2/6</td>
<td>Basics of Strain (Fossen Ch 2) Strain Ellipse/Ellipsoid Strain States</td>
<td>Understanding the Strain Ellipse (M&amp;M Chap 15)</td>
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<td>3: 2/13</td>
<td>Measuring Strain (Fossen Ch 3) Force &amp; Stress (Fossen Ch 4-5) Mohr Circle for Stress</td>
<td>Measuring Strain in Nature (M&amp;M Chap 15)</td>
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<td>4: 2/20</td>
<td>Stress States &amp; Trajectories Rheologic Behavior (Fossen Ch 6-7) Stress-Strain Relationships</td>
<td>Understanding Stress (handout)</td>
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<td>5: 2/27</td>
<td>Brittle Failure I-Tensile Cracking (Fossen Ch 7) Brittle Failure II-Shear Failure/Sliding Exam #1 - 03/01/2012 (est)</td>
<td>Stereonets I: Plotting Lines &amp; Planes (M&amp;M Ch 5)</td>
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<td>6: 3/5</td>
<td>Fracture Classification (Fossen Ch 7) Fracture Origin &amp; Interpretation Veins</td>
<td>Stereonets II: Poles &amp; Stereoplot Analysis (M&amp;M Ch 6 &amp; 8)</td>
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<td>7: 3/12</td>
<td>Faults I-Descriptive Terminology (Fossen Ch 8) Faults II-Fault Rocks &amp; Slip Determination Faults III-Mechanics</td>
<td>Cagle’s Mill Fracture Field Trip (M&amp;M Ch 12) OR Contour Map Analysis (M&amp;M Ch 2 &amp; Wilk Ch 7)</td>
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<td>8: 3/19</td>
<td>Folds I-Des Term &amp; Classification (Fossen Ch 11) Folds II-Fold Types Folds III-Kinematics/Mechanics</td>
<td>Cross Section Analysis I: Down-Plunge Projections &amp; Fold Profiles (M&amp;M Ch 13-14)</td>
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<td>9: 3/26</td>
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<td>10: 4/2</td>
<td>Foliations/Lineations (Fossen Ch 12-13) Cleavage Ductile Shear Zones (Fossen Ch 14-15)</td>
<td>Cross Section Analysis II: Balancing &amp; Restoration (M&amp;M Ch 14; Fossen Ch 20)</td>
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<td>11: 4/9</td>
<td>Exam #2 - 04/12/2012 (est) Seismic Imaging &amp; Interpretation Contractional Tectonics (Fossen Ch 16)</td>
<td>Geologic Map Analysis (M&amp;M Ch 9 &amp; Wilk Ch 8)</td>
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<td>12: 4/16</td>
<td>Fold-Thrust Belts I-Architecture (Fossen Ch 16) Fold-Thrust Belts II-Structural Families Fold-Thrust Belts III-Case Studies</td>
<td>Geologic Map Analysis (M&amp;M Ch 9 &amp; Wilk Ch 8)</td>
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<td>14: 4/30</td>
<td>Strike-Slip Systems I: Architecture (Fossen Ch 18) Strike-Slip Systems II: Settings/Case Studies</td>
<td>Baraboo, WI Field Trip (Brunton-M&amp;M 1) Depart Fri 5/4 @12 pm Return Sun 5/6 @ ~5 pm</td>
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<td>15: 5/7</td>
<td>History of Appalachians History of NA Cordillera Review &amp; Summary</td>
<td>Seismic Interpretations of Structural Styles (handout)</td>
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Exam #3 (Structural Families in Tectonic Settings): SAT, May 12, 2012 8:30-11:30 am, Rm 223 Julian

Note: These topics and exam times are subject to change.

All students who are 21 years of age are asked to become certified for driving University vehicles. 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? Experience has shown that students do better in class when they are engaged in the note-taking process, so I want you to take your own notes during lecture.

Should we copy all the text on the slides? No. 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 I expect you to know that detail for the exams.

Can we have an exam review sheet? I always do oral Q&A reviews before every exam to clarify geoscience concepts. It is important to hone your skills in synthesizing material for key concepts and essential factual information rather than relying on a review sheet.