APPLIED SCIENCE AND MANAGEMENT DIVISION
GEOL 208
3 Credit Course
Fall, 2021

COURSE OUTLINE

GEOL 208

STRUCTURAL GEOLOGY

3 CREDITS

PREPARED BY: Joel Cubley, Instructor/Coordinator
DATE: December 11, 2019

APPROVED BY: Stephen Mooney, Acting Dean, Applied Science and Management
DATE: December 13, 2019

APPROVED BY ACADEMIC COUNCIL: January 15, 2020

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Academic Council, Governance Office
Academic Council MyYC: Policies, Procedures and Forms

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STRUCTURAL GEOLOGY

INSTRUCTOR:	**OFFICE HOURS:**
OFFICE LOCATION:	**CLASSROOM:**
E-MAIL:	**TIME:**
TELEPHONE:	**DATES:**

COURSE DESCRIPTION

This course addresses the fundamental techniques in structural geology, including the mechanics of rock deformation, classification of tectonic structures in stratified and non-stratified rocks, and manipulation of structural data and its predictive use. The links between geological structures, mineral deposits, and exploration and mining practices are examined throughout the course, as is the interplay between deformation and plate tectonics. Students will spend considerable time learning how to understand structural data presented in geological maps and cross sections, as well as eventually developing those materials from their own data.

PREREQUISITES

Successful completion of GEOL105 (Physical Geology) and/or permission from the instructor.

EQUIVALENCY OR TRANSFERABILITY

Geology 208 has established equivalency with the following institutions:

Simon Fraser University: EASC 204 (3)
University of British Columbia: EOSC 323 (3)
University of British Columbia – Okanagan: EESC 1xx (3)
University of Victoria: EOS 202 (1.5)
Vancouver Island University: GEOL 202 (3)

LEARNING OUTCOMES

Upon successful completion of the course, students will be able to

Upon successful completion of the course, students will have demonstrated the ability to

- Accurately describe all types of common structures exposed at the earth's surface.
- Measure a variety of geologic structures in the field (planes, lineations, fold axes, etc.).
- Analyze the geometry of structures using stereographic and orthographic projections.
- Interpret geological maps in 3D using cross sections and block diagrams.
- Make informed interpretations of structural evolution, based on structural geometry, kinematics and mechanical principles.
- Correlate small scale structures with the regional tectonic framework.

COURSE FORMAT

This course consists of two 90-minute lectures and one 3-hour lab period per week. The lecture schedule included in this course outline details the major topics covered and when those topics will be presented throughout the course. Please note that this schedule will likely be modified throughout the term, as some topics may not be finished within the predicted lecture time. Laboratory exercises will be conducted in both laboratory and field settings.

ASSESSMENTS:

Attendance & Participation

Students are strongly encouraged to attend all lectures and laboratory exercises. Lab exercises can be completed only during lab periods and materials will not be available outside these hours. Off-campus field exercises must be completed during the allocated time with the instructor present.

Assignments
Weekly lab exercises will be due at the start of the following lab section. In addition to these exercises, students will be assigned several short theory assignments for the lecture segment of the course.

Supplemental readings from the course textbook will also be assigned to support lecture instruction. Students should expect to spend 1-2 hours on textbook readings per week, in addition to 3-4 hours outside of class on laboratory/lecture exercises.

Late assignments will be graded based on the following scheme: a deduction of 10% per day up until a total deduction of 50% is reached, following that, assignments must be submitted prior to the date that the instructor hands back the graded assignment (set by the instructor).

Tests
Any student who is absent from a test or exam for legitimate reasons will be eligible to write a deferred exam. Please note that excuses such as car trouble, vacation travel, oversleeping, and misreading the test schedule are not considered legitimate reasons and do not qualify the student for a deferred exam. For missed exams, the student must contact the instructor within 48 hours of the missed exam by phone or email. For missed final exams, students must contact the instructor to discuss an appropriate course of action. Any deferred exams will be scheduled by the Chair.

EVALUATION:

Tests and Assignments	***Weight***	***Dates***
Weekly Lab Assignments	40% (4% each)	Due at the start of each subsequent lab section.
Lab Final Exam	20%	During scheduled lab time in the final week of classes.
Lecture Midterm Exam	10%	During scheduled class time.
Lecture Final Exam	20%	During the final exam period.
Lecture Theory Assignments	10% (2.5% each)	To be determined.
Total	100%	

REQUIRED TEXTBOOKS AND MATERIAL

Davis, G.H., Reynolds, S.J. and Kluth, C.F. 2012. Structural Geology of Rocks and Regions (3rd ed.). Wiley, Mississauga, ON. 864 p.

Additional resources (available in the Geological Technology laboratory)

Fossen, H. 2010. Structural Geology (1st ed.). Cambridge University Press, New York. 463 p.

ACADEMIC AND STUDENT CONDUCT

Information on academic standing and student rights and responsibilities can be found in the current Academic Regulations that are posted on the Student Services/ Admissions & Registration web page.

PLAGIARISM

Plagiarism is a serious academic offence. Plagiarism occurs when a student submits work for credit that includes the words, ideas, or data of others, without citing the source from which the material is taken. Plagiarism can be the deliberate use of a whole piece of work, but more frequently it occurs when students fail to acknowledge and document sources from which they have taken material according to an accepted manuscript style (e.g., APA, CSE, MLA, etc.). Students may use sources which are public domain or licensed under Creative Commons; however, academic documentation standards must still be followed. Except with explicit permission of the instructor, resubmitting work which has previously received credit is also considered plagiarism. Students who plagiarize material for assignments will receive a mark of zero (F) on the assignment and may fail the course. Plagiarism may also result in dismissal from a program of study or the College.

YUKON FIRST NATIONS CORE COMPETENCY

Yukon College recognizes that a greater understanding and awareness of Yukon First Nations history, culture and journey towards self-determination will help to build positive relationships among all Yukon citizens. As a result, to graduate from ANY Yukon College program, you will be required to achieve core competency in knowledge of Yukon First Nations. For details, please see www.yukoncollege.yk.ca/yfnccr.

ACADEMIC ACCOMMODATION

Reasonable accommodations are available for students requiring an academic accommodation to fully participate in this class. These accommodations are available for students with a documented disability, chronic condition or any other grounds specified in section 8.0 of the Yukon College Academic Regulations (available on the Yukon College website). It is the student's responsibility to seek these accommodations. If a student requires an academic accommodation, he/she should contact the Learning Assistance Centre (LAC): lac@yukoncollege.yk.ca.

LECTURE TOPIC OUTLINE

Session	Topic (*lab activities in italics)*	Recommended Textbook Readings
1	Course introduction, primary versus deformational structures, types of structural analysis	Davis Ch. 1 (2-33)
2	Transformations, kinematics, displacement vectors, rigid vs. non-rigid body deformation, pure vs. simple shear	Davis Ch. 2 (35-58; 78-81)
3	Strain: strain ellipse, elongation, 1D and 2D strain, Flinn diagrams, introduction to quantification methods	Davis Ch. 2 (59-77), Ch. 9 (520-525); Fossen Ch. 3 (56-61)
4	Introduction to Stress**:** force, tractions; stress notation, normal vs. shear stresses and calculation; mean and deviatoric stress; principal stresses	Davis Ch. 3 (90-116)
5	Mohr stress diagrams, hydrostatic stress, cohesive strength, role of pore fluid pressure	Davis Ch. 3 (118-120); Fossen Ch. 4 (74-75), Ch. 7 (127-129)
6	Deformational behaviour (rheology): elastic, plastic, and viscous behaviour; common laboratory testing techniques, controls on deformational behaviour	Davis Ch. 3 (120-146)
7	Deformation mechanisms and microstructures I: point defects and dislocations, microfracturing and cataclasis, grain boundary rotation, frictional sliding	Davis Ch. 4 (148-162); Fossen Ch. 7 (120-121)
8	Deformation mechanisms and microstructures II: mechanical twinning, diffusion creep, pressure solution (dissolution creep), dislocation creep, recrystallization	Davis Ch. 4 (162 – 181) Fossen Ch. 10 (207-214)
9	Joints: joints vs. shear fractures, fracture modes, initiation and propagation, fracture criteria, deformation bands	Davis Ch. 5 (193 – 212; 236-239)
10	Faults: naming and classification, deformation textures and fault rocks, strain significance of major fault types	Davis Ch. 6 (249-286); Fossen (152-161)
11	Compressional regimes and thrust faulting: regional overthrusting and thrust terminology, critical taper/orogenic	Davis Ch. 6 (305-320); Fossen Ch. 16 (312-328).

	wedge models, thrust geometries, fault propagation folds	
12	Extensional regimes and normal faulting: blind and growth fault propagation, dilationary structures, relay ramps, low-angle detachments, orogenic collapse and core complexes	Davis Ch. 6 (321-333); Fossen Ch. 17 (334 -350)
13	Strike-slip faulting models: releasing and restraining bends, Riedel shears, flower structures, transpression and transtension	Davis Ch.6 (334-343) Fossen Ch. 18 (356-368)
14	Folds: geometric description, parallel vs. similar folding, anticlines vs. synclines, parasitic folds and Pumpelly's rule, cylindrical vs. conical folds	Davis Ch. 7 (345-365, 375-383)
15	Folding models and secondary related structures: flexural slip vs. flexural flow, passive slip vs. passive flow, kink folding	Davis Ch. 7 (390-403)
16	Cleavage: types (continuous, spaced, crenulation), strain significance, origins (pressure solution; grain rotation), axial planar cleavages	Davis Ch. 9 (463-486); Fossen (244-254)
17	Foliation development: phyllitic texture, schisosity and gneissosity, mylonitization and mylonite classification	Davis Ch. 9 (492-500**)**
18	Lineations: types of lineations (mineral, intersection; crenulation, boudin, mullion), tectonites, kinematics from lineations	Davis Ch. 9 (501-512); Fossen Ch. 13 (260-279)
19	Shear zones I: general characteristics, geometries, types (brittle, ductile, brittle-ductile), softening mechanisms, coaxial and noncoaxial deformation	Davis Ch. 10 (531-555); Fossen Ch. 15 (286-297)
20	Shear zones II: shear sense indicators (e.g. offset markers, foliation patterns, shear bands, S-C fabrics, mica fish, pressure shadows, en echelon veining)	Davis Ch. 10 (555 – 576); Fossen Ch. 15 298-306)
21	Progressive deformation: instantaneous and finite strain ellipses, progressive pure and simple shear, scale dependence	Davis Ch. 10 (586-598); Fossen Ch.2 (44-48)
22	Review – structural data collection (linear and planar features), proper data recording guidelines. Short field excursion	n/a

	(in Whitehorse) to practice fold description and data collection.	
23	Data processing and interpretation from Takhini Assemblage field trip	n/a

Laboratory Schedule

Session	Topic
1	Introduction to orientations of planes and lines, apparent dip and unit thickness
2	Methods of strain quantification
3	Mohr circles, failure envelopes, and pore pressure
4	Introduction to stereonet analysis (plotting planes, lineations, and poles)
5	Stereonets: apparent dips, rotations, and angular relationships
6	Stereonets: joint and fault analyses (contouring, rose diagrams, principal stresses)
7	Stereonets: fold analyses (β-diagrams, π-girdles, fold axes, interlimb angles, axial planar cleavages)
8	Cross sections and fold construction: angular kink fold and busk arc fold models
9	Cross-sections: projection of structural data into line of section, basics of cross-section balancing
10	Introduction to structural geology (stereonet) software
11	Field Trip: Structural analysis of the Takhini Assemblage, field data collection