APPLIED SCIENCE AND MANAGEMENT DIVISION
SCHOOL OF MINING AND TECHNOLOGY
SCHOOL OF SCIENCE

COURSE OUTLINE

GEOL 111

STRUCTURAL GEOLOGY

90 HOURS
3 CREDITS

PREPARED BY: _____ DATE: December 16, 2015
Joel Cubley, Instructor

APPROVED BY: _____ DATE: December 16, 2015
Margaret Dumkee, Dean

YUKON COLLEGE

Course Outline prepared by Joel Cubley, 16 December 2015.

Yukon College
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APPLIED SCIENCE AND MANAGEMENT DIVISION
GEOLOGY 111
3 Credit Course

STRUCTURAL GEOLOGY

INSTRUCTOR:	Dr. Joel Cubley
OFFICE HOURS:	Mondays, 1-3 p.m.
OFFICE LOCATION:	T1090
TELEPHONE/E-MAIL:	465-8605 / jcubley@yukoncollege.yk.ca

COURSE OFFERING:	January 6 – April 27, 2014
DAYS & TIMES:	Lectures: Mondays and Wednesdays, 10:30 a.m.- 12:00 p.m. (C1440) Laboratory: Fridays, 1:00 p.m.- 4:00 p.m. (T1090)

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.

LEARNING OUTCOMES

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.

DELIVERY METHODS/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.

PREREQUISITES

Successful completion of GEOL105 and/or permission from the instructor.

COURSE REQUIREMENTS/EVALUATION

Attendance and 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 a number of short theory assignments for the lecture segment of the course.

Tests/Exam

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%	

The letter-grading scheme used in this course is the standard college scheme. Final grades will be rounded up to the nearest decimal place and assigned a letter grade based on this scheme. Grades will not be raised in order to facilitate a better overall grade standing at the end of the course. Final grades will be changed in the event that an error in grade addition or entry occurs. In such a case, students are asked to contact the instructor immediately. The College policy on grading and related matters is described in the "Student Evaluation, Grades, and Records" section of the current College Calendar.

Plagiarism

Plagiarism involves representing the words of someone else as your own, without citing the source from which the material is taken. If the words of others are directly quoted or paraphrased, they must be documented according to recommended document style. The resubmission of a paper for which you have previously received credit is considered a form of plagiarism.

Plagiarism is academic dishonesty, a serious academic offence, and will result in you receiving a mark of zero (F) on the assignment or the course. In certain cases, it can also result in dismissal from the College.

Writing Centre

All students are encouraged to make the Writing Centre a regular part of the writing process for coursework. Located in C2231 (adjacent to the College Library), the Writing Centre offers half-hour writing coaching sessions to students of all writing abilities. Coaching sessions are available in person and through distance technologies (e.g. Skype or phone plus email). For further information or to book an appointment, visit the Centre's website: dl1.yukoncollege.yk.ca/writingcentre.

STUDENTS WITH DISABILITIES OR CHRONIC CONDITIONS

Reasonable accommodations are available for students with a documented disability or chronic condition. It is the student's responsibility to seek these accommodations. If a student has a disability or chronic condition and may need accommodation to fully participate in this class, he/she should contact the Learning Assistance Centre (LAC) at (867) 668-8785 or lassist@yukoncollege.yk.ca.

REQUIRED TEXTBOOKS/MATERIALS

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 (on reserve at the Yukon College library)

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

EQUIVALENCY/TRANSFERABILITY

No transfer agreements have yet been established for GEOL111.

Structural Geology Tentative 2016 Schedule

Date	Topic (*lab activities in italics)*	Recommended Textbook Readings
January 6th	Course introduction, primary versus deformational structures, types of structural analysis	Davis Ch. 1 (2-33)
January 8th	*Introduction to orientations of planes and lines, apparent dip and unit thickness*	
January 11th	Transformations, kinematics, displacement vectors, rigid vs. non-rigid body deformation, pure vs. simple shear	Davis Ch. 2 (35-58; 78-81)
January 13th	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)
January 15th	*Methods of strain quantification*	
January 18th	Introduction to Stress**:** force, tractions; stress notation, normal vs. shear stresses and calculation; mean and deviatoric stress; principal stresses	Davis Ch. 3 (90-116)
January 20th	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)
January 22nd	*Mohr circles, failure envelopes, and pore pressure*	
***January 25th**	Deformational behaviour (rheology): elastic, plastic, and viscous behaviour; common laboratory testing techniques, controls on deformational behaviour	Davis Ch. 3 (120-146)
***January 27th**	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)
January 29th	*Introduction to stereonet analysis (plotting planes, lineations, and poles)*	
February 1st	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)
February 3rd	Joints: joints vs. shear fractures, fracture modes, initiation and propagation, fracture criteria, deformation bands	Davis Ch. 5 (193 – 212; 236-239)
February 5th	*Stereonets: apparent dips, rotations, and angular relationships*	
February 8th	Faults: naming and classification, deformation	Davis Ch. 6 (249-

	textures and fault rocks, strain significance of major fault types	286); Fossen (152-161)
February 10th	Compressional regimes and thrust faulting: regional overthrusting and thrust terminology, critical taper/orogenic wedge models, thrust geometries, fault propagation folds	Davis Ch. 6 (305-320); Fossen Ch. 16 (312-328).
February 12th	*Stereonets: joint and fault analyses (contouring, rose diagrams, principal stresses)*	
February 15th	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)
February 17th	Midterm Lecture Exam Review	n/a
February 19th	**Midterm Lecture Exam**	
February 22/24/26	**No Class, Reading Week**	
February 29th	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)
March 2nd	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)
March 4th	*Stereonets: fold analyses (β-diagrams, π-girdles, fold axes, interlimb angles, axial planar cleavages)*	
March 7th	Folding models and secondary related structures: flexural slip vs. flexural flow, passive slip vs. passive flow, kink folding	Davis Ch. 7 (390-403)
March 9th	Cleavage: types (continuous, spaced, crenulation), strain significance, origins (pressure solution; grain rotation), axial planar cleavages	Davis Ch. 9 (463-486); Fossen (244-254)
March 11th	*Cross sections and fold construction: angular kink fold and busk arc fold models*	
March 14th	Foliation development: phyllitic texture, schisosity and gneissosity, mylonitization and mylonite classification	Davis Ch. 9 (492-500**)**
March 16th	Lineations: types of lineations (mineral, intersection; crenulation, boudin, mullion), tectonites, kinematics from lineations	Davis Ch. 9 (501-512); Fossen Ch. 13 (260-279)
March 18th	*Cross-sections: projection of structural data into line of section, basics of cross-section balancing*	
March 21st	Shear zones I: general characteristics, geometries, types (brittle, ductile, brittle-ductile), softening mechanisms, coaxial and noncoaxial	Davis Ch. 10 (531-555); Fossen Ch. 15 (286-297)

	deformation	
March 23rd	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)
March 25th	*Introduction to structural geology (stereonet) software (Stereo32)*	
March 28th	Progressive deformation: instantaneous and finite strain ellipses, progressive pure and simple shear, scale dependence	Davis Ch. 10 (586-598); Fossen Ch.2 (44-48)
****March 30th**	Review – structural data collection (linear and planar features), proper data recording guidelines. Short field excursion (in Whitehorse) to practice fold description and data collection.	n/a
April 1st	*Field Trip: Structural analysis of the Takhini Assemblage, field data collection*	
April 4th	Data processing and interpretation from Takhini Assemblage field trip	n/a
April 6th	Interpreting regional structures from geologic maps; characteristic fault patterns and relationship to dip angle; drawing sketch cross-sections to visualize relationships	n/a
April 8th	***Final Laboratory Exam***	
April 11th	Final Lecture Exam Review	n/a

*Online lectures available on Moodle. J. Cubley is Vancouver at the AMEBC Mineral Exploration Roundup.

**Activity will likely run into the lunch hour. Please bring a lunch to eat in the field.