

Earth Science 2281B - Geology for Engineers – January 2018

Description: Introduction to physical geology with emphasis on the engineering oriented aspects of the Earth Sciences. Topics include; minerals and rocks; mass movements; interpretation of aerial photographs, topographic and geologic maps; surficial processes and their manifestations; surface and ground water; structural geology and subsurface processes; and earth resources. 2 lecture hours, 3 laboratory hours (0.5 course)

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Antirequisites: Earth Science 1022a/b, 1081a/b, 1082a/b, or 1023/2123 a/b

Prerequisites: Register in second, third, or fourth year Civil and Environmental Engineering or permission of department

- *Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.*
- *Accessibility Statement: Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.*
- *Students who are in emotional/mental distress should refer to Mental Health@Western <http://www.uwo.ca/uwocom/mentalhealth/> for a complete list of options about how to obtain help.*

Learning Outcomes

Upon successful completion of this course students will be able to:

- Identify major minerals, igneous, sedimentary, and metamorphic rocks through laboratory-based assessment.
- Perform selected engineering geology evaluations and identify typical weathering products within engineering materials.
- Apply knowledge of Earth dynamics and structural geology to assess relative risks of earthquake activity and the impact on engineering structures.
- Apply knowledge of mass wasting processes and weathering to assess the mechanics of slope movements, slope stability processes and risks.
- Explain surface and ground water flow dynamics with respect to effective water resource management and subsurface characterization within fluvial plains and coastal areas.
- Identify features of glacial deposits on topographic maps, air photos, and other imagery.
- Explain how glacial cycles create complex subsurface deposits which impact ground water flow and geotechnical evaluations.
- Create links between Canada's resource rich economy, including oil, gas, and mineral deposits, and geologic processes.
- Effectively communicate the nature of dynamic earth processes and relative risks associated with various engineering works.

Required textbooks

Laboratory Manual in Physical Geology, 11th Edition, American Geological Institute, National Association of Geoscience Teachers, Pearson, 2017, ISBN-13: 978-0134446608

Laboratory Manual IS REQUIRED:

1. A large number of figures / tables used in lectures are from lab manual and will not be reproduced in the lecture notes.
2. **All** students are required to submit *worksheets* (questions, coloured maps / airphotos) directly from laboratory exercise manual. No black & white photocopies of required manual pages will be accepted.

Course Outline

Lecture Topics	Laboratory Exercises
Jan. 09 – Course objectives and relevance to Engineering – Rock cycle; Earth Dynamics; Minerals	Jan. 10, 11 – No Lab
Jan. 16 – Igneous Rocks	Jan. 17, 18 – Mineral properties and Identification
Jan. 23 – Weathering, Sedimentary Rocks	Jan. 24, 25 – Igneous Rock Identification
Jan. 30 – Metamorphic Rocks; Geologic Time	Jan. 31, Feb. 01 – Sedimentary Rock Identification
Feb. 06 – Crustal Deformation and Structures	Feb. 07, 08 – Metamorphic Rock Identification, RQD, PN
Feb. 13 – Earthquakes – faults, seismology, case studies	Feb. 14, 15 – Relative age dating, Geologic structures, maps, block diagrams
Feb. 27 – Midterm exam; in-class; see Owl announcement for assigned room location.	Feb. 28, Mar. 01 – Laboratory Exam (minerals and rocks); You will be allowed to bring in ONLY pages 85 to 92, 111, 135 from your lab manual + the sedimentary and metamorphic rock ID charts provided in the lecture notes – pages 20 and 24).
Mar. 06 – Mass Wasting and slope processes	Mar. 07, 08 – Earthquake hazards, Topographic maps
Mar. 13 – Surface water and river processes	Mar. 14, 15 – Stream processes, mass wastage, flood hazards
Mar. 20 – Groundwater – movement, contamination	Mar. 21, 22 – Groundwater processes, resources, risks
Mar. 27 – Glaciers – processes and landforms	Mar. 28,29 – Glacial processes and landforms, airphoto interpretation.
Apr. 03 – Energy and Mineral Resources	Apr. 04, 05 – lab pickup for final exam
Apr. 10 – Energy and Mineral Resources	

Required materials

For the mineral and rock identification laboratories, you will require a 10x hand lens (magnifying glass). These can be easily found from online vendors for ~ \$6 to \$10 (search 10x magnifier glass or loupe). For the map exercises, you will require a millimeter ruler, coloured pencils, protractor, and calculator

Lecture Material: The text portion of the lecture presentation slides will be made available on OWL. Figures used in the lectures come from the lab manual, various web links, government sources, or consulting reports. Material with disclosure issues (e.g. consulting reports), will not be posted on OWL. You are expected to attend lectures and make additional notes to guide you through the lecture material. The main purpose of the lectures is to help you understand how Earth Sciences and Civil Engineering are closely linked. Case studies / consulting reports give you the real-world application demonstrating these links.

Lectures: Tues 9:30 – 11:20 a.m. PAB 148

Laboratories: Section 002 - Wed. 1430 to 1730 hrs., rm. 1015 BGS
Section 003 - Thurs. 0830 to 1130 hrs., rm. 1015 BGS

Exams and Mark Distribution: Exams will be closed book (definitions; short answer; problem solving). A pencil, ruler, eraser, and basic calculator (basic math & geometry functions; but no extensive non-volatile memory capability).

A calculator is to be used for calculations only and not storage of information - any recall of such stored information will be considered a scholastic offense (cheating). No other electronic devices will be allowed. Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf.

In-class quizzes	8%	4 random dates; 2 prior to midterm, 2 after midterm (2% each)
Midterm exam	30%	Feb. 27 (during normal class 9:30 to 11:20 a.m.; see Owl for exam room)
Lab exam #1	12%	Feb. 28, March 01 (on your normal registered lab day and time)
In lab assignments	8%	9 assignments
Final exam	42%	(31% lecture material; 12% lab exam #2; 3 hours total for both)

Laboratory Outline

An assignment will be given for each laboratory session which will have two components. Assigned pre-lab reading and questions from the laboratory manual should be worked on prior to the lab. It is due at the beginning of the lab. During the lab additional questions are assigned (see note at top of next page) which must be completed and handed in by the end of the lab. While answers to questions will be provided on OWL you are to use these only to check your work – not copy. Handing in answers from previous years or other sources, including answers from colleagues working with you in the lab, will be considered a Scholastic Offence and handled according to normal policies see

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf.

➤ *If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to the Dean's office as soon as possible and contact your instructor immediately. It is the student's responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor has been informed. In the event of a missed final exam, a "Recommendation of Special Examination" form must be obtained from the Dean's Office immediately. For further information please see the Policy on Accommodation for Medical Illness at:*

www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_illness.pdf

➤ *For work worth less than 10% (e.g. individual assignments) if accommodation is required for medical or non-medical reasons email the instructor. In these cases either an extension will be given or a re-weighting to other components of the course – at the instructors discretion – will be done.*

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Note: Question(s) in purple will be marked provided prelab is complete and ‘During Lab’ assignment is complete. The prelab will be handed back to you during the lab. If entire lab assignment is not complete, purple lab portion will not be marked and you will receive 0.

L a b	Date	Topic	Prelab Assignment (AGI Lab Manual 11 th Ed.) - Due at start of Lab -	Assignment During Lab (AGI Lab Manual 11 th Ed.); <i>GTA's will provide additional samples & questions for each lab - Due at end of Lab -</i>
1	Jan. 17, 18	Mineral properties and identification	Read Lab 3 p.70-84 Activity 3.1A, 3.2A-I	Activity 3.4* *samples 1-15, 17, 18, 21, 22, 25 (see key), GTA question
2	Jan. 24, 25	Igneous rocks and identification	Read Lab 5 p.124-138, do Activity 5.1A, 5.2A-C, 5.4, 5.5	Activity 5.7 *samples I-1, 2, 4-11, 13 (see key), GTA question
3	Jan. 31, Feb. 01	Sedimentary rocks, processes and identification	Read Lab 6 p.150-168, do Activity 6.1A, 6.2A, 6.5A	Activity 6.6*, 6.7 *samples S-2 to 9, 11, 13, 15, 16 (see key), GTA question
4	Feb. 07, 08	Metamorphic rocks, processes and identification + core recovery / RQD + PN	Read Lab 7 p.186-195, do Activity 7.1A, 7.2A-E Read Core Loss and RQD handout (see OWL)	Activity 7.4*, *samples M-1 to 5, 8 (see key); complete lab 4 handout on cores & PN.
5	Feb. 14, 15	Relative age dating, Geologic structures, maps, block diagrams	Read Lab 8 p.208-214, do Activity 8.2A. Read Lab 10 p.266-278, do Activity 10.2	Lab 10 - Activity 10.3, 10.4, 10.5A-F
	Feb. 28, Mar. 01	Rock & Mineral Lab Exam	bring ONLY pages 85 to 92, 111, 135 from your lab manual + the sed. and metam. rock ID charts provided in the lecture notes – pages 20 and 24).	Bring your hand lens
6	Mar. 07, 08	Earthquake Hazards, Topographic Maps	Read Lab 16 p.410-416, do Activity 16.1C-D, 16.2A-E Read Lab 9 p. 232-252, do Activity 9.1A-C, 9.2A-F	Lab 16 – Activity 16.3, 16.5 Lab 9 – Activity 9.3A-B, 9.4A, 9.5A-F, 9.6A
7	Mar. 14, 15	Stream Processes, mass wastage, and flood hazards	Read Lab 11 p.294-306, do Activity 11.2A-B, 11.5A-E	Activity 11.4, 11.6, 11.7A,E
8	Mar. 21, 22	Groundwater processes, resources, risks	Read Lab 12 p.326-336, do Activity 12.2, 12.4	Activity 12.3, 12.5, 12.6A
9	Mar. 28, 29	Glacial processes and landforms, airphoto interpretation	Read Lab 13 p.348-366, do Activity 13.2	Activity 13.4, 13.5, airphoto sets provided by GTA questions below:
<p>1. The airphoto pair provided is of an area in the Peterborough region. Consider the shape, orientation, and grouping of the dominant glacial landforms on the airphoto and answer the following questions:</p> <p>a) On your left airphoto outline and identify / name two of these landforms, and using these landforms show the direction of glacier movement (use an arrow).</p> <p>b) Locate any eskers, kames or kettle lakes in the area. Circle and identify one of each on the left airphoto.</p> <p>2. On the left airphoto draw a line between the end moraine and ground moraine. Clearly colour / identify the end moraine material. Mark high and low areas and show direction of glacier movement.</p>				
	Apr. 04, 05	Lab pickup for final exam		

Mineral and Rock Name Key

Minerals

1	Talc
2	Gypsum
3	Calcite
4	Fluorite
5	Halite
6	Quartz: massive/crystal
7	Garnet:massive/crystal
8	Hornblende (Amphibole)
9	Augite(Pyroxene)
10	Orthoclase(K Feldspar)
11	Plagioclase(Labradorite)
12	Muscovite
13	Biotite
14	Hematite
15	Magnetite
17	Pyrite
18	Chalcopyrite
21	Galena
22	Graphite
25	Olivine

Igneous Rocks

I-1	Obsidian
I-2	Rhyolite
I-4	Granite
I-5	Granite
I-6	Granite
I-7	Diorite
I-8	Basalt
I-9	Gabbro
I-10	Volcanic Breccia
I-11	Pumice
I-13	Andesite Porphyry

Sedimentary Rocks

S-2	Fossiliferous Limestone
S-3	Oolitic Limestone
S-4	Dolostone (Dolomite)
S-5	Rock Gypsum
S-6	Coal
S-7	Shale
S-8	Chalk
S-9	Conglomerate
S-11	Quartz Sandstone
S-13	Siltstone
S-15	Chert
S-16	Rock Salt

Metamorphic Rocks

M-1	Marble	M-4 Quartzite
M-2	Slate	M-5 Schist
M-3	Gneiss	M-8 Phyllite