

General information

Instructor: Roberta Flemming: B&GS 0172, rflemmin@uwo.ca

Teaching assistants: Victoria Houde (vhoude@uwo.ca) and Fengke Cao (fcao23@uwo.ca)

Lectures: Tuesdays and Thursdays, 10:30-11:20 am, Kresge Building KB-K106

Laboratory: Tuesday 2:30-5:30 pm, B&GS 1069

Office hours: Tuesday 11:30-12:20. You can also drop by at any time (except the hour before class or lab!), but I cannot guarantee that I will be in my office, outside of office hours.

Purpose: In this course, we will examine aspects of mineral external morphology and internal crystal structure, mineral chemistry and stability. Mineral stability will be viewed in terms of compatibility of atomic substitution in minerals (phase diagrams, solid solution, exsolution), and bonding theories (Pauling's bond valence, crystal field theory, molecular orbital (MO) theory and band theory). We will also examine mineral stability from the thermodynamic perspective (Gibb's Free Energy). Other topics include crystal growth, X-ray powder diffraction, Electron probe microanalysis (EPMA), colour in minerals and other mineral physics concepts (pyroelectricity, piezoelectricity, magnetic properties, elastic properties). Selected silicate minerals will be examined in detail.

Laboratory exercises will enhance the students' understanding of concepts learned in class. Presentations will allow students to pursue topics of particular interest to themselves while improving oral communication skills. In-class presentations will expose the class to a wide variety of mineralogical topics of current interest, while improving students' verbal communication skills.

Prerequisites: Earth Sciences 2206a/b; **Co-requisites:** Earth Sciences 2230a/b, or registration in a Materials Science module. 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.

Course topics/themes - Tentative schedule

Crystallography

- Week 1: Jan 5 Class cancelled
- Week 2: Jan 10, 12 Review: Crystal systems, symmetry and axes. External morphology (forms) and Miller indices
- Week 3: Jan 17, 19 Crystal growth, defects; twinning, polymorphism, polytypism
- Week 4: Jan 24, 26 Internal symmetry and lattice translation. X-ray diffraction (XRD), micro X-ray diffraction (μ XRD)

Mineral Chemistry

- Week 5: Jan 31, Feb 2 Atomic packing (Pauling's Rules) in simple crystal structures (metals, oxides, sulfides)
- Week 6: Feb 7, 9 Bonding; Determining mineral formulae from chemical analyses
- Week 7: Feb 14, 16 Electron microprobe (EPMA) and plotting chemical compositions (binary, ternary)

***** Reading Week – February 20-24 *****

Mineral Stability

- Week 7: Feb 28, Mar 2 Mineral stability I: Thermodynamics, Gibbs free energy; **Midterm (Mar 2)**
- Week 8: Mar 7, 9 Mineral stability II: Thermodynamics of mixing, solid solution, polymorphism
- Week 9: Mar 14, 16 Mineral stability III: Thermodynamics cont'd, ordering and exsolution, geothermobarometry

Silicate Mineralogy

- Week 10: Mar 21, 23 Guest Lectures TBA (Flemming at Lunar and Planetary Science Conference – Texas)
- Week 11: Mar 28, 30 Detailed look at selected silicate minerals; Crystal field theory and colour in minerals

Mineral Physics

- Week 13: Apr 4 Mineral Physics: Pyroelectricity, piezoelectricity, magnetic, elastic properties

Laboratory Exercises - Tentative schedule

Labs	Date	Topic
Week 1:	Jan 10	No Lab
Week 2:	Jan 17	Lab 1. External morphology – real crystals
Week 3:	Jan 24	Lab 2. External Morphology – Shape program
Week 4:	Jan 31	Lab 3. Internal Symmetry and translation – repeating patterns
Week 5:	Feb 7	Lab 4a. X-ray diffraction of unknown mineral – sample preparation and analysis
Week 6:	Feb 14	Lab 4b. X-ray diffraction of unknown mineral – identification using ICDD database
*****		Conference Week – February 20-24 *****
Week 7:	Feb 28	Lab 5. Electron probe microanalysis: Data interpretation; plotting on composition diagrams
Week 8:	Mar 7	Lab 6. Working with phase diagrams and plotting on ternary composition diagrams
Week 9:	Mar 14	Lab 7. Thermodynamics and mineral stability
Week 10:	Mar 21	No Lab: (Flemming is at the Lunar and Planetary Science Conference in Texas)
Week 11:	Mar 28	Student Presentations
Week 12:	April 4	Student Presentations

Evaluation

Marks:	Midterm Exam*+: (50 min)	March 2	20%	
	Lab assignments: (7)	Due weekly (beginning of the next week's lab)	25%	
	Mineralogy Topic:	Selected topic from list provided by instructor		
		Topic due: January 24 (beginning of class)		
		Outline due: February 14 (beginning of class)		
		Abstract and references: due: March 14		5%
		Presentation: Mar 28 or Apr 4 (by lottery, Mar 14)		10%
		Handout: (2 pages) to be given out at presentation		5%
	Participation:	In class, and questions during student presentations		5%
	Final Exam*:	(2 hr) TBA		30%

* NOTE: Calculators will be allowed during tests and exams. No makeup midterm test will be given.

For students with a legitimate reason for not attending, this 20% will be added to the weight of the final exam.

+ NOTE: If a student improves their grade in their final exam by 10% over their grade in the midterm test, the student's final exam will be given full weight (50%) and the midterm grade will be discounted.

[+ ALSO NOTE: The above incentive does not apply if the student fails to write the midterm exam.]

Readings

Text:

Klein, C. and Dutrow, B. (2008) *Manual of Mineral Science*, 23rd Ed. Wiley, NY.

Additional readings:

You will be responsible for additional readings, assigned in lectures. This material will be made available in Taylor library.

Optional texts:

Putnis, A. (1992, 1993, 1996, 2001) *Introduction to Mineral Sciences*, Cambridge University Press. Cambridge, UK. (Available used)

Deer, W., Howie, R., Zussman, J. (1992) *An Introduction to the Rock Forming Minerals*, 2nd Ed., Longman, New York.

Ethical Conduct: 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/handbook/appeals/scholoff.pdf>.

Plagiarism: Students must write their assignments in their own words. Whenever you take an idea, or a passage from another author, you must acknowledge this both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence.

In case of medical illness:

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 Academic Counselling 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 Academic Counselling immediately.

For further information please see: <http://www.uwo.ca/univsec/handbook/appeals/medical.pdf>

A student requiring academic accommodation due to illness, should use the Student Medical Certificate when visiting an off-campus medical facility or request a Records Release Form (located in Academic Counselling) for visits to Student Health Services.

The form can be found here: https://studentservices.uwo.ca/secure/medical_document.pdf

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.