EES 5401: Analytical Methods in Mineralogy (4 credits)

Fall 2017

Meeting Time and Location: TTh 8:00 – 9:20, Beury 303  
Lab Section: Tues 4:00 – 5:50, Beury 303 (or as directed)

Instructor: Prof. Steven Chemtob

Office: Beury 325

(215) 204-3958

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Office Hours: by appointment

Required texts**:**   
There are no required textbooks. Suggested readings will be assigned and posted on the Blackboard site.

Some texts that I can recommend, from which I will be drawing lecture material:

Harris and Bertolucci, *Symmetry and Spectroscopy: An Introduction to Vibrational and Electronic Spectroscopy*, 1989.

Henderson, Neuville, and Downs, eds. *Spectroscopic Methods in Mineralogy and Materials Sciences*. Reviews in Mineralogy and Geochemistry, vol. 78, 2014.

Beran and Libowitzsky, eds. *Spectroscopic Methods in Mineralogy*, EMU Notes in Mineralogy, vol. 6, 2004.

Moore and Reynolds, *X-Ray Diffraction and the Identification and Analysis of Clay Minerals*, 1997.

Policies:

**Attendance:** Classroom attendance is required.

**Exams:** There will be a midterm and a final exam, each worth 20% of the total course grade. Make-up exams will be allowed only with prior approval and a valid excuse.

**Basis for Grading:**

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| --- | --- |
| Homeworks and Lab Reports | 30% |
| Midterm | 20% |
| Final exam | 20% |
| Independent Project (*see below*) |  |
| Report and written materials | 25% |
| Presentation | 5% |

**Independent Research / Term Paper**

A major portion of the grade will be an independent research effort and term paper. This assignment is intentionally open-ended in its requirements, but it must cover **a method for characterizing the mineralogy or chemistry of geological materials**. You must present and offer interpretation for some data. These datasets could be original (collected here at Temple, using XRD, FTIR, ICP-OES, XRF, or another method) or entirely literature-based. You could discuss an analytical method that we don’t discuss in this course, or a particular application of a method that we do discuss. If you’re having trouble thinking of something, let me know.

Students must choose their independent project topic by ***Tuesday, October 4th****.* Please submit a ~1 page proposal/abstract in class that day.

The products of this project will be:

A detailed outline and reference list, due **November 7th.** We’ll have brief one-on-one progress reports that week.

A 10- to 15- page (double-spaced) report, including a brief background and literature review, data figures, and interpretations, due **November 30th**.

10-minute presentations on your topic during class on **December 7th**.

You will receive more information about the paper requirements (formatting, etc.) soon.

**Tentative Schedule of Topics (subject to change!)**

|  |  |  |
| --- | --- | --- |
| Week of | Topics | Homework / Lab |
| August 28th | Course overview  **XRD:** Properties of X-rays and interactions of X-rays with matter | No lab |
| Sept 4th | **XRD:** single phase identification; sample preparation techniques | **Lab:** Introduction to XRD and mineral identification |
| Sept 11th | **XRD:** Analysis of mineral mixtures and rocks; Rietveld refinement | **Lab:** Analyzing mineral mixtures |
| Sept 18th | **XRD:** Olivine and pyroxene solid solutions; clay mineral analyses | **Lab:** Rietveld refinement |
| Sept 25th | **Infrared and Raman spectroscopy:** group theory and symmetry | **Lab:** Forensic analysis/ FTIR overview |
| Oct 2rd | **Infrared and Raman spectroscopy:** methods, sample prep, and phase identification  ***No class Oct. 5th*** | **Lab/HW:** Beer’s Law / symmetry effects  **Proposals for paper due in class Oct. 5th** |
| Oct 9th | **Infrared and Raman spectroscopy:** Water and hydroxyl in minerals. *End of material to be covered by midterm* | **Lab:** Raman spectroscopy |
| Oct 16th | **Raman spectroscopy:** applications **Midterm exam, Thurs, Oct. 19th** | No Lab / HW |
| Oct 23th | **Optical spectroscopy & origin of color in minerals** | **Lab:** Colors of transition metals in solution |
| Oct 30th | **Reflectance spectroscopy & remote sensing** | **Lab:** Diffuse reflectance |
| Nov 6th | **Geochemical methods** | **Lab:** ICP-OES  **Outlines, Nov. 7th**  **One-on-one meetings** |
| Nov 13th | **Geochemical methods**  **X-ray absorption spectroscopy:** theory and XANES | **Lab:** XRF |
| Nov 20st | *No classes (Fall break / Thanksgiving)* | |
| Nov 27th | **X-ray absorption spectroscopy:** EXAFS | **Paper due** |
| Dec 4th | Presentations on independent study | No Lab / HW |
| Dec 13th | Final exam, take-home. |  |