

**GEO 246**  
**X-ray Diffractometry**  
**Fall, 2018**

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**Office Hours:** I am in the office all day every day (except for professional travel), and welcome you to stop in at any time. If you have difficulty finding me, please contact me by email and we can set up a formal appointment.

**Course Description, GEOL 246 X-ray Diffractometry:** This course focuses on identification and characterization of materials using X-ray diffractometry. The course will include exercises using a modern powder diffractometer. *Prerequisite:* Introductory chemistry. *Credits:* 3

**Course Objectives.** This course is designed to teach the fundamentals of safe use of an X-ray diffractometer in analyzing crystalline materials. The course will consist of lecture classes to teach X-ray diffraction theory and safety, and include numerous laboratory exercises in the analysis of geologic and synthetic materials. At the end of the course you will be able to:

1. Safely use the X-ray powder diffractometer.
2. Identify materials on the basis of their X-ray diffractogram.
3. Understand the theory behind X-ray diffraction.
4. Use the diffractometer for advanced techniques such as Rietveld analysis.

**Tentative Laboratory Exercises.** The list of tentative laboratory exercises is attached.

**Evaluation.** Your grade will be based on your performance on the final exam (20%) and your work in the laboratory (70%) and the final project (10%). You will be given help on the lab exercises, and there is no reason not to hand in "perfect" assignments. The final exam, scheduled by the Registrar's Office, is set for: 10:30pm – 1:15, Friday, December 14, 2018. However, in the past I have made the final take-home (often a more effective learning experience), and we will discuss that possibility and finalize our decision by October 2. **Graduate students in the course will be expected to undertake a more extensive project.**

**Final Project.** The Powder diffractometer is a powerful tool, and one that you may rely on throughout your scientific career. For that reason, I am requiring a Final Project that will comprise 10% of your grade. The project can be related to your research or simply a project that piques your interest. I would be pleased to help you select a project as the semester progresses.

The project should be such that it consumes about 10% of your time in the course, and is not expected to be a major undertaking. A brief summary of the project and the results will be due on the last day of classes.

## Tentative Lecture Schedule

8/28 ..... The powder diffractometer; Characteristics of X-rays  
8/30 ..... X-ray Safety; Radiation Safety Training by the Office of Radiation Safety  
9/4, 9/6,  
9/11, 9/13.....The powder diffractometer; Characteristics of X-rays;  
9/18, 9/20,  
9/25.....Bragg's Law and scattering  
9/28, 10/2,  
10/4..... Crystallography review; space group determination using X-rays  
10/9,  
10/11, 10/16.... Absorption of X-radiation  
10/18, 10/23  
10/25, 10/30....The structure factor and calculation of X-ray intensities; systematic absences  
11/1,  
11/6, 11/8.....Solution of crystal structures [Note: I will be out of town for GSA on 11/3; we will plan around that dates.]  
11/13, 11/15..... Rietveld analysis of mixed materials and structure determination by PXRD

## THANKSGIVING RECESS

11/27..... Rietveld analysis of mixed materials and structure determination by PXRD  
11/29..... Feldspar structural state  
12/4, 12/6..... Summary, problems

### Readings:

Readings will be assigned from *American Mineralogist*, which are available on-line with open access at: <http://www.minsocam.org/MSA/AmMin/TOC/>

In addition, readings will be assigned principally from two books, and they will be available for use in the X-ray laboratory. If access to them becomes difficult, I will purchase another copy of each. The books are:

*Elements of X-ray Diffraction*, B. D. Cullity and S. R. Stock, 3<sup>rd</sup> Edition (2001).

*X-rays, Electrons and Analytical Chemistry: Spectrochemical Analysis with X-rays*, H. A. Liebhafsky, H. G. Pfeiffer, E. H. Winslow, P. D. Zemany and S. Liebhafsky, Wiley-Interscience, New York, 1972, p. 290.

**Academic Integrity:** The University of Vermont maintains a Code of Academic Integrity, which can be viewed at: <http://www.uvm.edu/policies/student/acadintegrity.pdf>. As a student at the University, you are required to adhere to the policy. If you are not familiar with the policy, you should access it at the above site and review its contents. Enrollment in this course requires you to read and understand this policy; if you have any questions, please see me.

**Religious Holidays:** As quoted from UVM Policy, *Students have the right to practice the religion of their choice. Each semester students should submit in writing to their instructors by the end of the second full week of classes their documented religious holiday schedule for the semester. Faculty must permit students who miss work for the purpose of religious observance to make up this work.* To access the policy, please visit:

[http://www.uvm.edu/academics/catalogue2006-07/?Page=allpolicies.php&SM=policymenu.html&category=academic\\_policies&policy=Rights%20and%20Responsibilities%20of%20Undergraduate%20Students](http://www.uvm.edu/academics/catalogue2006-07/?Page=allpolicies.php&SM=policymenu.html&category=academic_policies&policy=Rights%20and%20Responsibilities%20of%20Undergraduate%20Students).

### Fall 2018

Events	Dates	Days of Week
First Day of Classes	Aug 27	M
Last Day to Add Classes without Instructor Permission	Aug 31	F
Labor Day Holiday	Sep 3	M
Add/Drop, Pass/No Pass, Audit Deadline <sup>1</sup>	Sep 10	M
Fall Recess	Oct 8	M
Last Day to Withdraw <sup>1</sup>	Oct 29	M
Thanksgiving Recess	Nov 19-23	M-F
Last Day of Classes	Dec 7	F
Reading Days <sup>2</sup>	Dec 8,9,12	Sa,Su,W
Exam Period	Dec 10-14	M-F
Exam Days <sup>2</sup>	Dec 10,11,13,14	M,T,R,F