**Spring 2025 | GEOL 1090 | Geochemistry**

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**Professor:** Ryan Kerrigan
**Office:** Krebs 113C
**Office Hours:** Tues. 1-3 or by appointment
**E-mail:** kerrigan@pitt.edu
**Office Phone:** (814) 269-2942
**Class time:** Tuesday and Thursday, 9:30 AM-10:50 AM
**Class Room:** Krebs B52

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***Welcome to Geochemistry!***

Geochemistry is an interdisciplinary subject that explores the common ground between the more traditional subject of chemistry and geology. In this context, the purpose of this course is to examine the chemistry of natural waters (both surface and subsurface), radiogenic isotopes, and trace element partitioning through the application of thermodynamic and kinetic models of geologic environments at low to moderate temperatures. The basic objective is to gain a broader understanding of how chemical reactions control geologic processes.

**Goals and Outcomes**
By the end of this course, students will have:

- An understanding of basic thermodynamic and kinetic principles with respect to geochemical systems.
- An introductory knowledge of radiogenic and stable isotope systematics
- An understanding of trace element behavior in a wide range of geologic systems.
- An ability to determine fate-and-transport of various chemicals, especially common pollutants

**COURSE RESOURCES AND RULES**

**Text (required):** Introduction to Geochemistry, 2012, Misra, K.C., Wiley Publishing Company, p. 438. ISBN-10: 9781405121422, ISBN-13: 978-1405121422.You can find this online for as low as $60, however, new copies run about ~$60 on Amazon. Additionally, I have asked the library to have a copy on reserve. You will complete assignments using it and I will refer to its contents in lecture frequently.
https://ndl.ethernet.edu.et/bitstream/123456789/60723/1/Kula%20C.%20Misra_2012.pdf

**Web-material:** Most (not all) class materials (schedule, power points, problem sets, study guides, etc.) will be posted on Canvas for your convenience.

**Electronics:** I prefer that you do not use electronics. I know some people like to take notes on their laptops or tablets, I get it, but I don't have to like it… I just want your focus to be on the lecture you're attending. If you're going to flip through 30 second videos, can you do it someplace else?

**Clean-up:** Please don't make a mess, but if you choose to make a mess, please clean up after yourself.

**Safety:** Use your brain, do not do anything that would endanger yourself or your classmates.

**Accommodations:** If you have a disability for which you are, or may be, requesting an accommodation, you are encouraged to contact both the instructor and the Office of Health and Wellness (G-10 Student Union Building, 814-269-7119) to schedule an appointment as early as possible in the term. The Office of Health and Wellness will verify your disability and determine reasonable accommodations for this course.

**Academic Integrity:** Although there will be opportunities for group work in this course, all students are responsible for understanding the material and should indicate with whom they collaborated on any assignment. Group work does not mean that one person does all the work and everyone else puts their name on it…this is considered cheating. Students **should not:** claim other's ideas as their own, turn in other's work as their own, copy sources without proper citation (plagiarism), allow others to take their work or ideas, or pass off past projects as original work. If you have questions about academic honesty, see the instructor or refer to the document "Academic Integrity at the University of Pittsburgh at Johnstown." (http://www.upj.pitt.edu/en/academics/academic-affairs/academic-advising/academic-integrity/). Anyone found to be in violation of the Pitt-Johnstown standards for academic integrity will fail the course. We will cover scientific ethics in this course, until then use your brain.

**Late Work:** Any work not received by the due date and time will have points deducted, except when pre-excused by the instructor (which will require documentation). Up to 10% of the total possible points will be deducted each day late (this includes weekends and holidays). No late work will be accepted after the last day of classes.

**Outside Resources:** Perhaps there are questions that I cannot answer, or issues you feel you cannot discuss with me, UPJ has outlets these issues. Kara Bernard, the division administrative assistant, is a wealth of knowledge about random stuff. If you have a problem with me or a problem you don't feel comfortable talking to me about, please see: Steve Stern, the Natural Science Division Chair; he is my bosses.

## EVALUATION

**1. Problem Sets:**
Problem sets will be distributed biweekly, they will be handed out on Mondays and will be collected the following two weeks later unless otherwise specified. The problem sets will be a combination of calculations, short answer, essay, or summaries of assigned reading. Problem sets will heavily reinforce topics discussed and covered in class so attendance to class will be imperative. If for some reason you are unable to attend class, please contact your classmates about the missed material. The problem sets will be worth 30% of your total grade.

**2. Exams:**
There will be three-unit exams during the semester (including the final). The tentative dates of these exams are shown in the Course Schedule found below. The exams will be a combination of short answer/drawings/labeling/calculations/etc. The exams will comprise 50% of your total grade. The first two exams will be 15% each of your total grade. The final exam will be held **DATE AND TIME in Krebs B52** and will be a cumulative exam worth 20% of your total grade.

Exams will emphasize material presented in lecture; however, students will also be tested on material contained in the readings. Exams will not just test your factual knowledge of the material; students will also be expected to *apply* your knowledge and understanding of the course material. In this regard, it is of prime importance to understand geologic concepts, more than just "facts." Some memorization will be necessary, but is considered of secondary importance. Exams are closed-book. There are no make-up exams. If you know you will be missing an exam, see me and we may be able to arrange to have you take the exam early.

**3. Research Paper and Presentation:**
Students will be asked to complete a semester-long research project that will culminate in the presentation of the independent investigation. The term project will revolve around some piece of open-source software that focuses on geochemistry. You will be tasked with becoming familiar with the software, presenting its

strengths and weaknesses to the class. Additionally, you will be asked to develop an exercise associated with software. The software will be discussed in a written report and presented to the class. A separate sheet will be distributed discussing expectations, timelines, formats, and potential topics.

## ASSESSMENT

- 30% Problem Sets
- 50% Exams (first two exams will be 15% each and the cumulative final will be 20%)
- 20% Research Paper and Presentation
- Standard grade cut-off apply (100-96.6 =A+, 96.6-93.3=A, 93.3-90=A-, etc)

## TENTATIVE CLASS SCHEDULE

| Course Schedule | | |
|---|---|---|
| **Week** | **Tuesday** | **Thursday** |
| **1** | **January 7, 2025**<br>**NO CLASS** | **January 9, 2025**<br>*Introduction to Geochemisty*<br>Chapt. 1 (1-6) |
| **2** | **January 14, 2025**<br>*Atomic Structure: Principles*<br>Chapt. 2 (7-22) | **January 16, 2025**<br>*Atomic Structure: Chemical Behavior* |
| **3** | **January 21, 2025**<br>*Chemical Bonding: Bonding Types*<br>Chapt. 3 (23-48) | **January 23, 2025**<br>*Chemical Bonding: Bonding Types*<br>**Problem Set #1 Due** |
| **4** | **January 28, 2025**<br>*Basic Thermodynamic Concepts: Chemical Equilibrium*<br>Chapt. 4 (49-78) | **January 30, 2025**<br>*Basic Thermodynamic Concepts: Laws & Functions* |
| **5** | **February 4, 2025**<br>*Basic Thermodynamic Concepts: Computation* | **February 6, 2025**<br>*Thermodynamics: Potential & Gases*<br>*Chapt. 5 (79-106)*<br>**Problem Set #2 Due** |
| **6** | **February 11, 2025**<br>*Thermodynamics of Solutions: Mixing Laws* | **February 13, 2025**<br>**EXAM I** |
| **7** | **February 18, 2025**<br>*Geothermometry & Geobarometry: Basic thermo & barmetric tools*<br>Chapt. 6 (107-133) | **February 20, 2025**<br>*Geothermometry & Geobarometry: Uni & Divarient Reactions* |
| **8** | **February 25, 2025**<br>*Reactions Involving Aqueous Sol: Activity & Solubility*<br>Chapt. 7 (134-166) | **February 27, 2025**<br>*Reactions Involving Aqueous Sol: Dissolution & Precipitation*<br>**Problem Set #3 Due** |

| Course Schedule | | |
|---|---|---|
| **Week** | **Tuesday** | **Thursday** |
| **9** | **March 4, 2025**<br><br>**NO CLASS**<br>**SPRING BREAK** | **March 6, 2025**<br><br>**NO CLASS**<br>**SPRING BREAK** |
| **10** | **March 11, 2025**<br>*Oxidation-Reduction Reactions:*<br>*Eh & Fugacity*<br>Chapt. 8 (167-196) | **March 13, 2025**<br>**Problem Set #4 Due**<br>*Kinetics: Basic Principles*<br>Chapt. 9 (197-222) |
| **11** | **March 18, 2025**<br>*Kinetics of Chemical Reactions:*<br>*Temperature Dependance* | **March 20, 2025**<br><br>**EXAM II** |
| **12** | **March 25, 2025**<br>*Radiogenic Isotopes:*<br>*Radioactive Decay & Geochronology*<br>Chapt. 10 (225-252) | **March 27, 2025**<br><br>**NO CLASS**<br>**Northeast GSA** |
| **13** | **April 1, 2025**<br>*Radiogenic Isotopes:*<br>*U-Th Systematics*<br>Chapt. 10 (225-252) | **April 3, 2025**<br>*Radiogenic Isotopes:*<br>*Ratios as Petrogenetic Indicators*<br>**Problem Set #5 Due** |
| **14** | **April 8, 2025**<br>*Stable Isotopes:*<br>*Stable Isotope Geothermometry*<br>Chapt. 11 (253-280) | **April 10, 2025**<br>*Stable Isotopes:*<br>*Evaporation and Condensation* |
| **15** | **April 15, 2025**<br>*The Core-Mantle-Crust System:*<br>*Earth & Magmas*<br>Chapt. 12 (281-325) | **April 17, 2025**<br>*The Core-Mantle-Crust System:*<br>*Petrogenetic Indicators*<br>**Problem Set #6 Due** |
| **16** | **April 22, 2025**<br>**Research Paper**<br>**Presentations** | **April 24, 2025**<br>**Final Exam**<br>**8:00-10:00** |