

**COURSE SYLLABUS**  
**ERTH425/SUST425 -- ENVIRONMENTAL GEOCHEMISTRY**

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**Target Audience and Course Content:**

This class is about natural processes of Earth's surface and the impacts of human activities on environments. Both global and local phenomena will be examined from a chemical perspective. It is suited for students who:

- are preparing for a career in the environmental and geotechnical fields in industry or academia
- want to know more about the chemistry of phenomena in the environment around them
- plan to pursue an advanced degree such as the EARTH MS or Doctoral degree.

We will cover natural and anthropogenically perturbed aspects of the Earth's hydrosphere and its interaction with surface rocks, sediments, soils, the biosphere and the atmosphere. Topics will give insight into the science behind today's environmental issues. Course content is largely based on applied geochemistry, with supporting content in theoretical geochemistry, organic chemistry, inorganic chemistry, biochemistry, and microbiology. A student doesn't have to be a chemist by training or an environmentalist by temperament to succeed in this class.

*Topics include:*

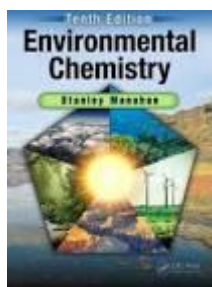
- Natural and anthropogenically perturbed aspects of the Earth's hydrosphere, atmosphere and biosphere, and their interaction with soils, sediments, manmade structures/facilities and ecosystems.
- remediation (repair of compromised environments); prevention (especially with respect to alternate practices in land and water use, and industrial and agricultural practices); modified end-of-pipe emissions practices
- Organic molecules in nature; Organic contaminants in ground water: sources, sinks
- Heavy metals in ground and surface waters, both natural and non-natural distributions.
- Particle-Aqueous Solute Interactions
- Aquatic Microbial Biochemistry
- The geochemistry of the atmosphere and atmospheric precipitation, "acid rain", the ozone layer, some atmospheric pollutants.
- The global carbon cycle, stable isotope geochemistry, atmospheric carbon dioxide and other greenhouse gases; Global Climate: Past, Present and Future.
- Energy, technology and resources
- Lakes, Rivers and estuaries: nutrient overloading, oxygen depletion, urban sewage.
- Drinking water and Sewage Water Treatment
- Chemical weathering, soil formation, geochemistry of clays, vadose groundwater composition.
- Natural radioactivity; Radioactive waste composition, storage and disposal.

**Grading:**

Is based on a curve. 1 Midterm exam (33% each); homework problem sets (33%); final project (33%) Class participation is not mandatory, but I do consider it in borderline grading situations. Please turn homework assignments in on time. I do not accept assignments once solutions are posted. Also, I apply grading penalties of 10%/day unless we have discussed your situation in advance.



## ERTH/SUST425 -- ENVIRONMENTAL GEOCHEMISTRY - Spring 2021



### Text:

Manahan "Environmental Chemistry", 10th Ed.

(see also the Table of Contents comparison to the 9<sup>th</sup> edition)

*Supplemental Reading:* will be provided as needed.

### Class Format:

This is a lecture course, *online by zoom this semester*. I encourage students to actively ask questions in class, particularly if the discussion isn't clear of if you want more information. Most important material will be discussed in class, but is typically covered in more detail in the reading assignments. Keeping up with the reading will help you get the most out of the lectures.

### Lecture Notes:

Download as adobe acrobat files from Laulima. See also the schedule on the course website (<http://www.soest.hawaii.edu/krubin/erth425-625-sched.html>). These are not required reading, nor are they a substitute for taking your own notes or reading the text. They are a guide to lecture content. Also, the notes include supplemental figures discussed in class that are not in the textbook. These will be useful for homework assignments and studying for exams.

### ERTH Learning Objectives:

ERTH department has defined 5 learning objectives for the undergraduate degree program related to Relevance of Geology and Geophysics, Technical knowledge, Scientific method, Oral and written skills, and Evaluating Phenomena. This course directly incorporates content relevant to 4 of those:

- SLO1 - throughout the course you will learn about the relevance of geochemistry to understanding and providing for human needs, and to impacts on society and planet Earth.
- SLO2 - you will solve problems using real world data sets
- SLO4 - you will reconstruct knowledge in a written report (final project).
- SLO5 - in all assignments you will evaluate, interpret, and summarize basic principles to explain complex phenomena at the interfaces of chemistry, geology, biology, hydrology, soil science, geography and human industry.

### Title IX:

- The University of Hawai'i is committed to providing a learning, working and living environment that promotes personal integrity, civility, and mutual respect and is free of all forms of sex discrimination and gender-based violence, including sexual assault, sexual harassment, gender-based harassment, domestic violence, dating violence, and stalking. If you or someone you know is experiencing any of these, the University has staff and resources on your campus to support and assist you. Staff can also direct you to resources in the community. Some of your options are:
- **As members of the University faculty, your instructors are required to immediately report any incident of potential sex discrimination or gender-based violence to the campus Title IX Coordinator.** Although the Title IX Coordinator and your instructors cannot guarantee confidentiality, you will still have options about how your case will be handled. Our goal is to make sure you are aware of the range of options available to you and have access to the resources and support you need.
- If you wish to remain ANONYMOUS, speak with someone CONFIDENTIALLY, or would like to receive information and support in a CONFIDENTIAL setting, use the **confidential resources available here:** <http://www.manoa.hawaii.edu/titleix/resources.html#confidential>
- If you wish to directly REPORT an incident of sex discrimination or gender-based violence including sexual assault, sexual harassment, gender-based harassment, domestic violence, dating violence or stalking as well as receive information and support, contact: Dee Uwono Title IX Coordinator (808) 956-2299 [t9uhm@hawaii.edu](mailto:t9uhm@hawaii.edu).



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### Tentative Class Schedule

| Week | Lecture | Topic   | Reading:<br>10 <sup>th</sup> ed.<br>Chapter | 8 <sup>th</sup> and<br>9 <sup>th</sup> Ed.<br>Equiv. |
|------|---------|---|---|--|
| 1    | 1,2     | Intro: Environmental Science & Environmental Geochemistry; Global environmental systems: the hydrologic and elemental cycles. Motions of the atmosphere and hydrosphere.<br><i>note: see self-study Chem 161/162 review pack - Aquatic Chemistry, inorganic substances, acids-bases, solubility, complexes;</i> | 1, 16<br>(especially 16.1-16.5)             | 1  |
| 2    | 3,4     | putting the hydrosphere and its processes in chemical perspective   | 2, & review<br>7 <sup>th</sup> Ed. Ch28     | 3 & 7 <sup>th</sup><br>Ed. Ch28                      |
| 3    | 5,6     | More Aquatic Chemistry: redox review, redox ladder Aquatic Microbial Biochemistry   | 3, 5  | 4, 6   |
| 4    | 7,8     | organic chem. intro, microbial biochemistry and transformations to organic matter, microbial role in nutrient cycling   | 5, 21 & 7 <sup>th</sup><br>Ed Ch 29         | 6, 22<br>& 7 <sup>th</sup> Ed<br>Ch 29               |
| 5    | 9,10    | BOD, OM and nutrient loading in the hydrosphere   | 4   | 5  |
| 6    | 11,12   | Particle-Aqueous Solute Interactions and Case Studies from estuarine and near shore marine environments   | 4   | 5  |
| 7    | 13,14   | Weathering and soil formation, agricultural soils; soil contaminants/remediation  | 14,15                                       | 15,16  |
| 8    | 15,16   | mass transfer phenomena, groundwater;   | 14  | 16   |
| 9    | 17,18   | Groundwater pollution: organic contaminants, remediation methods; Toxicology intro,<br><i>Take Home MIDTERM EXAM</i>  | 6, 19.11-<br>19.14,<br>22.1-22.5            | 7, 20, 23  |
|      |         | <i>spring break</i>   |   |  |
| 10   | 19,20   | Fresh Water pollution - Heavy Metals; Sustainable Drinking Water/water treatment  | 7   | 8  |
| 11   | 21      | wastewater treatment;+ flex day in case we need it  | 7   | 8  |
| 12   | 22,23   | Atmospheric chemistry; Atmospheric pollutants: halocarbons and stratospheric ozone , photochemical smog,  | 8, 10                                       | 9, 11  |
| 13   | 24,25   | Atmospheric pollutants acid rain, Global Climate: Past, Present and Future, atmospheric CO <sub>2</sub>   | 12, 13                                      | 13, 14   |
| 14   | 26,27   | Sustainable energy, technology and resources  | 17, 18                                      | 18, 19   |
| 15   | 28,29   | Radioactivity: Uses, hazards, environmental issues  | None  | None   |
| 16   | 30      | Radioactive materials case studies: a. Depleted Uranium; b. Sr-90/Y-90  | Tba   | Tba  |