

## COURSE SYLLABUS

### ERTH625 -- ADVANCED ENVIRONMENTAL GEOCHEMISTRY (*meets concurrently with EARTH425*)

**Instructor:** Ken Rubin

**How to find me:** *Email:* krubin@hawaii.edu

*Office:* POST 606E; *Office hrs:* tba.

*Phone:* x68973, x66836 (lab)

#### **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 chemical and ecological perspectives.

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
- are pursuing graduate degrees or research in Environmental Science.

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 need not be a chemist by training or an environmentalist by temperament to succeed in this class.

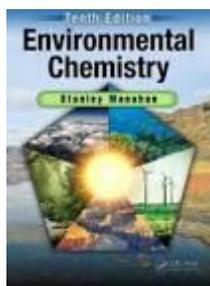
#### *Topics include:*

- Organic molecules in nature; Organic contaminants in ground water: sources, sinks, remediation techniques
- Heavy metals in ground and surface waters, both natural and non-natural distributions.
- Particle-Aqueous Solute Interactions
- Aquatic Microbial Biochemistry, ecological factors, pollutant toxicity
- 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
- Soils, agricultural contaminants, geochemistry of soil solids, vadose and saturated zone 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 considered in borderline grading situations. Please turn homework assignments in on time. Late assignments will not be accepted once solutions are posted. Also, grading penalties of 10%/day apply unless we have discussed your situation in advance.

## ERTH625 -- ADVANCED 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 and discussion course, *online by zoom this semester*. I encourage students to actively participate in class, particularly if the discussion isn't clear or if they 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 Lulima. 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.

### Learning Objectives:

ERTH department has defined 4 learning objectives for the MS degree and 5 for the PhD. This course addresses some of these:

- MS- SLO1 and PhD-SLO1 - proficiency in applying technical knowledge of theory, laboratory methods, field methods, computer applications, to the field.
- PhD SLO2 - ability to comprehensively synthesize, evaluate, and interpret relevant fundamental knowledge in her or his sub-discipline
- MS- SLO2 and PhD-SLO3 - students will learn about effective and ethical practice of the Scientific method.
- MS- SLO3 and PhD-SLO4 - Students will learn how to Communicate scientific knowledge through report writing
- MS- SLO4 and PhD-SLO5 - 4. Students will gain practical skills that are relevant to Employability and Contributions Post-Graduation to the advancement of the Earth sciences and/or the solution of societal problems.

### 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)

## ERTH425/625 -- ENVIRONMENTAL GEOCHEMISTRY - Spring 2021

## Tentative Class Schedule

Week	Lecture	Topic	Reading: 10 <sup>th</sup> ed. Chapter	8 <sup>th</sup> and 9 <sup>th</sup> Ed. Equiv.
1	1,2	Intro: Environmental Science & Environmental Geochemistry; Global environmental systems: the hydrologic and elemental cycles. Motions of the atmosphere and hydrosphere. <i>note: see self-study Chem 161/162 review pack - Aquatic Chemistry, inorganic substances, acids-bases, solubility, complexes;</i>	1, 16 (especially 16.1-16.5)	1
2	3,4	putting the hydrosphere and its processes in chemical perspective	2, & review 7 <sup>th</sup> Ed. Ch28	3 & 7 <sup>th</sup> 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> Ed Ch 29	6, 22 & 7 <sup>th</sup> Ed 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, <i>Take Home MIDTERM EXAM</i>	6, 19.11- 19.14, 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	Sustainable Drinking Water, sewage and wastewater treatment; flex day if 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

