Department of Chemistry and Geoscience

CHEM 253 Introduction to Environmental Chemistry

Course Outline - Fall 2004

A. General Information

Instructor: Neil Meanwell **Office**: F348B **Telephone**: 370-3448

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Office Hours: Monday: 11.30 am to 2:30 pm, Tuesday: 11.30 am to 1.30 pm, Wednesday: 11.30 am to1:30 pm, Thursday: 12.30 to 2.30 pm and Friday: 10:30 am to 11:30 am and 12.30 to 1.30 pm.

Scheduled Lectures: Monday: 9:30 - 10:20 am (F 300), Wednesday: 1:30 - 2:20 pm (F 360), and Friday: 9:30 - 10:20 am (F 300).

Scheduled Labs: Thursday: 2:30 - 5:20 pm (F 356)

B. Course Textbook *Environmental Chemistry, 3nd Edition, (Freeman), Colin Baird*

C. Lecture Material (with Chapter References)

1. General Introduction (supplemented with handouts)

Environmental science, biosphere, hydrosphere, geosphere, lithosphere, atmosphere, energy and energy cycles, matter and matter cycles, humans and pollution, anthrosphere, effects of the anthrosphere on Earth.

2. The Chemistry of Natural Waters (Chapters 8)

Properties of water, hydrologic cycle, oxidation-reduction chemistry in natural waters, solubility of oxygen in water, Henry=s law, oxygen demand, chemical and biochemical oxygen demand, anaerobic decomposition of organic matter, aerobic and anaerobic conditions, pE scale, sulphur and nitrogen compounds in water, acid mine drainage.Acid-base chemistry in natural waters - the carbonate system, water in equilibrium with calcium carbonate, water in equilibrium with carbon dioxide, water in equilibrium with calcium carbonate and carbon dioxide, measured ion concentrations in natural waters and drinking water, alkalinity and acidity, hardness index for natural waters, aluminum, metal complexation, other chemical species in water.

3. Toxic Organic Chemicals (Chapter 6)

Pesticides including herbicides and insecticides, organochlorine compounds, principles of toxicology, dose-response relationships, other types of modern insecticides, herbicides. Other notable organic pollutants including dioxins, PCBs, and polynuclear aromatic hydrocarbons (PAHs). Long range transport of atmospheric pollutants.

4. Toxic Heavy Metals (Chapter 11)

General features of heavy metals and their toxicity, bioaccumulation of heavy metals. Mercury, lead, cadmium, and arsenic.

5. Principles of Chemical Toxicology (Part of Chapter 7)

Acute and chronic toxicities, dose-response relationships, LD_{50}, no observable effects level (NOEL), risk assessment.

6. The Purification of Polluted Water (Chapter 10)

Contamination of groundwater, purification of drinking water, methods of disinfection. Treatment of wastewater and sewage. Modern wastewater and air purification techniques.

7. Principles of Atmospheric Chemistry (Parts of Chapters 1, 2, 3, 4, and 5)

Composition of the atmosphere, regions of the atmosphere, variation of atmospheric pressure with altitude, electromagnetic spectrum, fate of solar radiation, principles of photochemistry, atmospheric concentration units, kinetics of atmospheric reactions, radicals, excited states, and ions.

8. Topics in Atmospheric Pollution (Parts of Chapters 1, 2, 3, 4, and 5)

Topics to be covered in detail include ozone layer depletion, photochemical smog, acid rain, and the greenhouse effect.

9. Particles in the Atmosphere (Chapter 2)

Description and importance of atmospheric particles, physical characteristics, energy and mass transfer, basic chemical reactions in the atmosphere.

Physical behaviour of particles in the atmosphere, Stokes=s law, physical and chemical processes of particle formation, types of particles and their effects, Air Quality Index, PM index. Indoor air pollution.

10. Hazardous Waste (Chapters 12 and 13)

The nature of hazardous wastes, ignitability, corrosivity, reactivity, toxicity. Hazardous compounds and their classification, chemical classification of hazardous wastes. Radioactive waste. Hazardous waste and the environment. Leachate and leachate tests on contaminated sites.

D. Assignments

The first assignment will be based on topics learned in Chem 120 and Chem 121 which are most relevant to environmental chemistry. It will be distributed in week #1 and taken in and

marked at the beginning of week #5.
Further assignment questions will be distributed periodically to keep pace with the course material. The questions will be chosen from the questions given at the end of each chapter of the textbook. Some additional questions will also be given. The assignments will **not** be taken in for marking. Solutions will be posted periodically outside my office.

E. Exams

You will be required to take the following exams:

Midterm Exam #1 Week 7 - 120 minutes duration. Written exam on the lecture material presented from Week 1 to Week 6 of the course. Scheduled for the lab period of Week 7.

Midterm Exam #2 Week 12 - 120 minutes duration. Written exam on the lecture material presented from Week 7 to Week 11 of the course. Scheduled for the lab period of Week 12.

Final Exam 180 minutes duration. Written exam on **all** the lecture material presented in the course. Scheduled for the week immediately following the end of the semester.

Note: If you have to miss an exam through illness you must inform me as soon as possible to allow me to make alternative arrangements.

F. Laboratory Work

You will be required to perform a laboratory experiment each week of the semester except the first and last weeks and the weeks when exams are scheduled.

G. Course Mark

Review assignment	5%
Midterm exams (@ 15%)	30%
Final exam	35%
Laboratory work	30%

The Letter Grade
The following scale is used:

>95 A+	80-84 B+	65-69 C+	50-59 D	0-49 F
90-94 A	75-79 B	60-64 C		
85-89 A-	70-74 B-			

H. Intended Learning Outcomes

At the end of the course the student will be able to:

1. Describe the natural physical and chemical processes that occur in the environment, especially those pertaining to the atmosphere and the hydrosphere.

2. Use the specialized language and terminology of environmental chemistry.

3. Describe the effects of human activity upon the environment and comment on the properties of specific organic and inorganic pollutants.

4. Utilise the knowledge of the chemical and physical properties of substances to determine how various pollutants exert their effects on the environment both qualitatively and quantitatively.

5. Classify hazardous substances according to their properties and describe the approaches to their safe disposal.

5. Classify toxic substances according to type and use the terminology associated with chemical toxicology.

6. Perform numerous laboratory procedures involving the monitoring of various pollutants in the environment.