CAMOSUN COLLEGE	***School of Arts & Science*** ***CHEMISTRY AND GEOSCIENCE DEPARTMENT*** **CHEM 253-01** **Environmental Chemistry** **2008F**

COURSE OUTLINE

The Approved Course Description is available on the web @ _____

Ω *Please note: this outline will be electronically stored for five (5) years only.*
It is strongly recommended students keep this outline for your records.

1. Instructor Information

(a)	Instructor:	Neil Meanwell		
(b)	Office Hours:	Mon,Tues, Wed,: 9.30 – 10.30 am. Wed: 11.30 am – 12.30 pm. Fri: 10.30-11.30 am and 12.30 -1.30 pm		
(c)	Location:	F 348 B		
(d)	Phone:	370-3448	Alternative Phone:	(250)729-3838
(e)	Email:	meanwen@camosun.bc.ca or chemhelp@shaw.ca		
(f)	Website:	N/A		

2. Intended Learning Outcomes

(No changes are to be made to this section, unless the Approved Course Description has been forwarded through EDCO for approval.)

Upon completion of this 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. Utilize 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.
6. Classify toxic substances according to type and use the terminology associated with chemical toxicology.
7. Perform numerous laboratory procedures involving the monitoring of various pollutants in the environment.

3. Required Materials

(a) Texts

Environmental Chemistry, 3rd Edition, Colin Baird and Michael Cann, Freeman.

(b) Other Chem 253 Lab Manual, In-house

4. Course Content and Schedule

(Can include: class hours, lab hours, out of class requirements and/or dates for quizzes, exams, lectures, labs, seminars, practicums, etc.)

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 (Chapter 13)

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 (Chapters 10, 11, and 12)

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 15)

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

5. The Purification of Polluted Water (Chapter 14)

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

6. 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.

7. 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.

8. Particles in the Atmosphere (Chapter 3)

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.

9. Hazardous Waste (Chapter 16)

The nature of hazardous wastes, ignitability, corrosivity, reactivity, toxicity. Hazardous compounds and their classification, chemical classification of hazardous wastes. Radioactive waste.

10. Renewable Energy, Alternative Fuels, and the Hydrogen Economy (Chapter 8)

Renewable energy, alternative fuels, hydrogen as a fuel.

11. Radiaoctivity and Nuclear Energy (Chapter 9)

Radiactivity, radon, nuclear energy.

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.

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.

CHEM 253 Laboratory Experiments

1. **The Statistical Treatment of Data and the Measurement of some Physical Properties of Natural Waters**
   This experiment involves collecting a data set and applying a detailed statistical analysis to the data. A natural water sample is analysed to obtain measurements of *total suspended solids* (TSS) and *total dissolved solids* (TDS).

2. **Alkalinity and the Carbonate System**
   The pH and alkalinities of a number of natural water samples are determined. The data is then used to determine the actual concentrations of the various

species which contribute to the alkalinity and values for *dissolved inorganic carbon* (DIC) are determined.

3. **The Determination of Orthophosphate in Water**
   An effluent sample from a wastewater treatment plant is analysed for orthophosphate by the molybdenum blue spectrophotometric method.

4. **The Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) of a Polluted Water Sample**
   The BOD_5 of an influent sample from a wastewater treatment plant is measured and compared to the COD of the sample which is determined by titration.

5. **The Measurement of Dissolved Oxygen in Natural Waters**
   Students measure dissolved oxygen in water by the Winkler method and also calibrate a dissolved oxygen meter. The Winkler method is also used to explore the relationship between temperature and solubility, as well as the affect of salinity on oxygen solubility.

6. **The Determination of Fluoride in Water using an Ion-Selective Electrode**
   Water samples are analysed for fluoride with an ion-selective electrode. Students are shown how chemical interferences can be avoided, as well as the influence of ionic strength on measurements.

7. **Conductivity Measurements on Natural Waters**
   Conductivity measurements are performed on a range of natural water samples and the results used to estimate *total dissolved solids* (TDS). Students also learn some of the underlying theory of the conductivities of strong and weak electrolyte solutions, including specific conductance and limiting molar conductivity. The concentration of chloride in a natural water sample is determined using a conductometric titration.

8. **The Determination of Copper in Acid Mine Drainage Samples using Atomic Absorption Spectrophotometry**
   Contaminated soil samples from a disused copper mine on Vancouver Island are digested and analyzed for copper content using an AA spectrophotometer.

9. **An Introduction to Gas Chromatography**
   This experiment acts as an introduction to the technique of gas chromatography and its uses in environmental monitoring.

10. **Synthesis of Biodiesel and Analysis by Gas Chromatography**
    A sample of biodiesel is prepared from a used sample of cooking oil. The final product is analyzed for content by gas chromatography and compared to a commercial biodiesel sample.

5. Basis of Student Assessment (Weighting)

(Should be linked directly to learning outcomes.)

(a) Assignments 5%

(b) Quizzes

(c) Exams – 2 Midterms @ 15%; Final Exam 35%

(d) Other (e.g., Attendance, Project, Group Work) Laboratory work: 30%

6. Grading System

(No changes are to be made to this section, unless the Approved Course Description has been forwarded through EDCO for approval.)

Standard Grading System (GPA)

Percentage	Grade	Description	Grade Point Equivalency
90-100	A+		9
85-89	A		8
80-84	A-		7
77-79	B+		6
73-76	B		5
70-72	B-		4
65-69	C+		3
60-64	C		2
50-59	D	Minimum level of achievement for which credit is granted; a course with a "D" grade cannot be used as a prerequisite.	1
0-49	F	Minimum level has not been achieved.	0

Temporary Grades

Temporary grades are assigned for specific circumstances and will convert to a final grade according to the grading scheme being used in the course. See Grading Policy E-1.5 at **camosun.ca** for information on conversion to final grades, and for additional information on student record and transcript notations.

Temporary Grade	Description
I	*Incomplete*: A temporary grade assigned when the requirements of a course have not yet been completed due to hardship or extenuating circumstances, such as illness or death in the family.
IP	*In progress*: A temporary grade assigned for courses that, due to design may require a further enrollment in the same course. No more than two IP grades will be assigned for the same course. *(For these courses a final grade will be assigned to either the 3rd course attempt or at the point of course completion.)*

CW	*Compulsory Withdrawal:* A temporary grade assigned by a Dean when an instructor, after documenting the prescriptive strategies applied and consulting with peers, deems that a student is unsafe to self or others and must be removed from the lab, practicum, worksite, or field placement.

7. Recommended Materials or Services to Assist Students to Succeed Throughout the Course

LEARNING SUPPORT AND SERVICES FOR STUDENTS

There are a variety of services available for students to assist them throughout their learning. This information is available in the College calendar, at Student Services or the College web site at camosun.ca.

STUDENT CONDUCT POLICY

There is a Student Conduct Policy **which includes plagiarism**.
It is the student's responsibility to become familiar with the content of this policy. The policy is available in each School Administration Office, at Student Services and on the College web site in the Policy Section.

ADDITIONAL COMMENTS AS APPROPRIATE OR AS REQUIRED