CHEMISTRY 301 - Fall 2018
Aqueous Environmental Chemistry

Introduction to the properties and chemical composition of natural waters with an emphasis on chemical equilibria in controlling solubility and gas exchange. The role of pH, redox, complexation and ion-exchange on chemical speciation, distribution and remediation will be examined. Topics include nutrient ions, heavy metals and organic molecules, acid mine drainage, wastewater treatment and water purification technologies.

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Textbook:
Environmental Chemistry: Glob. Perspec. (4th Ed), **G.W. van Loon; S.J. Duffy**, 2017 (Required)
Aquatic Environmental Chemistry, **A.G. Howard**, Oxford Press, 1998 (Optional-Recommended)

Prerequisites: CHEM 140 & 141/142 **Recommended:** CHEM 221

Time and Location: 1:00-2:20 **T Th** B210-260 (eventually); B360-324
1:30-2:20 **M** B210-260 (eventually); B200-106

Office Hours: 11:00 – 12:00 **T Th** & **F**

Course Evaluation:

Research Assignment	10%
Case Study & Participation	15%
Problem Sets (4)	15%
Mid-Terms (2)	20%
Final Exam	40%

Additional Texts:
Environmental Chemistry, *2nd ed.*, **N. Bunce**, Wuerz Publishing, 1994
Elements of Environmental Chemistry, **R.A. Hites**, Wiley, 2007
Water Chemistry, **M.M. Benjamin**, McGraw-Hill Publishers, 2002
Consider a Spherical Cow: A course in environ problem solving, **J. Harte**, Univ Sci Books, 1988
Water Chemistry: Green Science and Technology of Nature's Most Renewable Resource, **S. Manahan**, CRC Press, 2010

Key Periodicals:
Environmental Science and Technology
Water Research

CHEM 301 ~ COURSE OUTLINE
AQUEOUS ENVIRONMENTAL CHEMISTRY

Introduction:
Environmental Chemistry, Properties of Water, Water Quality and Natural Water Bodies ***lecture notes Chapter 1***

Review of Important Chemical Principles and Units of Measure ***lecture notes review handout***

Equibrium constants: K_w, K_a, K_{sp} Acids/bases: pH, pK_a
Redox: oxidation states, E^o Thermodynamics: ΔG^o

Chemical Composition of Natural Water ***Readings: Chapter 9, 15.2 -15.4***
Hydrologic and biogeochemical cycles, role of dissolved gases and solids
Introduction to alkalinity, hardness, dissolved organic matter

Distribution of Chemical Species in Aquatic Systems ***Readings: Chapter 10***
Acid - Base Equilibria: carbonates, phoshates and ammonia equilbria
Redox Equilibria: electrode potentials, Nernst equation and pE
pE and pH relationships

Gases in Water ***Readings: Chapter 11***
Solubility of inert and reactive gases: Henry's law, temperature effects

Organic Matter in Water ***Readings: Chapter 12***
Origins, fate and chemical interactions involving humic material: DOM, POM
Anthropogenic molecules: surfactants, complexing agents, biocides

Metals in the Hydrosphere ***Readings: Chapter 13***
Classifications, complexes, phase interactions
pE-pH diagrams

Colloids and Surface Interactions ***Readings: Chapter 14***
Surface properties, adsorption phenomena, partitioning
Clay minerals and cation exchange capacity

Microbial Catalysis (brief) ***Readings: Chapter 15***
Oxidation: BOD, COD and TOC
Nitrification and Denitrification reactions: $pE^o(w)$

Water Pollution and Waste Water Treatment Chemistry ***Readings: Chapter 16, 19***
Types of water pollution
Treatment and disinfection chemistry: chlorination, ozonation and advanced oxidation
Remediation and waste disposal technologies

Case Studies: Various Topics
Mondays, 1:30 - 2:20, B200-106/B210-260

Handouts will be distributed throughout the course to supplement the course material.

Additional Resources for CHEM 301

Library Holdings

Aquatic Chemistry: Chemical Equilibria and Rates in Natural Waters, W Strumm and JJ Morgan GB 855 S78 1996

Aquatic Chemistry Concepts, JF Pankow GB 855 P36 1991

Aquatic Environmental Chemistry, A Howard GB 855 H68 1998

Basic Concepts of Environmental Chemistry, DW Connell TD 193 B37 1997

Canadian Water Quality Guidelines TD 226 C42

Chemistry of the Environment, TG Spiro and WM Stigliani TD 193 S7 2003

Clean Water: Water Quality and Water Pollution Control, KM Vigil [electronic resource]

Environmental Chemistry, C Baird TD 192 B35 1995

Environmental Chemistry, SE Manahan QD 31.2 M35 1994

Environmental Chemistry, N Bunce TD 193 B85 1994

Environmental Soil and Water Chemistry, VP Evangelou TD 878 E93 1998

Freshwater, EC Peilou GB661.2 P54 1998

Handbook of Chemical Technology and Pollution Control, MB Hocking TP 155 1998

Introduction to Natural Water Chemistry, GK Pagenkopf GB 855 P33 2000

The Physical Chemistry of Natural Waters, FJ Millero GB 855 M53 2001

Water Quality Data: Analysis and Interpretation, AW Hounslow TD 370 H68 1995

Water Chemistry, M.M. Benjamin GB 855 B46 2002

Personal Holdings

The above titles are also available in my office along with the following:

Elements of Environmental Chemistry, R.A. Hites, Wiley, 2007
Introductory Chemistry for the Environmental Sciences, RM Harrison and SJ de Mora,
An Introduction to the Chemistry of the Sea, MEQ Pilson
Principles and Applications of Aquatic Chemistry, FMM Morel and JG Hering
CO2 in Seawater: Equilibrium, Kinetics, Isotopes, RE Zeebe and D Wolf-Gladrow
The Drinking Water Handbook, FR Spellman and JE Drinan

Policy on Cheating and Plagiarism[1]

Cheating and plagiarism are serious offences. There are many forms of beating the system that are considered unacceptable methods of gaining credit. Experience has shown that it is impossible to define every version, and therefore each case tends to be judged separately. The overall aim is to prevent unjustified credit being obtained for work that is not one's own. The penalties for *attempting* to gain unjustified credit must necessarily appear harsh. It is just as serious for a lab report as for an exam. All lab instructors must refer suspicious situations to the course instructor. The penalties that will be applied include:

- **A mark of zero for the work in question**
- **Referral to the Vancouver Island University Administration, which may include penalties such academic probation or suspension**

For disciplinary actions taken by the administration refer to the General Information section of the Vancouver Island University Calendar and visit the website at *www.mala.ca/policies*.

The notes below give typical chemistry lab examples of situations that may help to clarify the broader definitions given in the Calendar.

- It is unacceptable to
  - record data from samples not prepared by the author without giving due credit to the donor
  - present someone else's data without acknowledging credit (with or without their knowledge)
  - falsify data
  - submit samples not prepared by the author.
- It is unacceptable to
  - use ideas or facts from any source without proper reference citation
  - copy another report or portions of a report, be it marked or not
  - copy written material (whether from books, journals, or a website) without using quotation marks. However, keep in mind that direct quotation is not a common practice in scientific writing.
- There is a fine distinction between discussing a lab before work is submitted and producing a collaborative effort. Even if collaborative discussion has taken place, the material submitted for assessment must be the result of the author's individual effort.
- A person *supplying* material for the purpose of someone else copying or cheating is considered to be equally accountable, and will be subjected to similar penalties.

VIU Grade Scale

A+	90-100	**B-**	68-71
A	85-89	**C+**	64-67
A-	80-84	**C**	60-63
B+	76-79	**C-**	55-59
B	72-75	**D**	50-54

[1] Adapted from *University of Victoria, Chemistry 235 Laboratory Manual, 2003* with the author's permission.