

## CHEMISTRY 311 ~ FALL 2017

### Environmental Chemical Analysis

Introduction to quantitative chemical analysis of water, sediments and biological samples. Additional topics include environmental sampling, quality control and the application of statistics in a laboratory setting. Labs include the analysis of dissolved gases, nutrient ions, metals and organic contaminants by volumetric, electrochemical, spectroscopic and chromatographic methods.

#### Instructors:

Dr. Erik Krogh, Bldg.360-Rm328, local 2307, Email: erik.[krogh@viu.ca](mailto:krogh@viu.ca), web.viu.ca/krogh

Dr. Chris Gill, Bldg. 360-Rm306, local 2303, Email: chris.gill@[viu.ca](mailto:viu.ca), web.viu.ca/gill

**Text:** *Quantitative Chemical Analysis*, 9<sup>th</sup> Edition, D.C. Harris, W.H. Freeman Publishers, 2016  
Online Resource for textbook <http://www.macmillanlearning.com/Catalog/studentresources/qca9e#>

#### Supplemental Materials on Library Reserve:

*Standard Methods for the Examination of Water and Wastewater*, 21<sup>st</sup> ed., 2005

*Environmental Sampling and Analysis: Lab Manual*, M. Csuros, CRC Lewis Publishers, 1997

*Canadian Drinking Water Guidelines*, Canadian Council of Resource and Environment Ministers

*British Columbia environmental laboratory manual for the analysis of water, wastewater, sediment and biological materials and discrete ambient air samples* [electronic resource]

*Water Quality and Pond Analysis for Aquaculture*, C.E. Boyd, C.S. Tucker, Auburn Univ. Press, 1992

**Lab Manual:** Available from VIU Bookstore.

**Prerequisites:** CHEM 140 and 142

**Recommended:** CHEM 213/221

<b>Time and Location:</b>	Lectures	8:30 – 9:50 <b>T, Th</b>	Bldg. 380-Rm201
	Laboratory	2:30-5:30 <b>F</b>	Bldg. 360-Rm201

**Office Hours:** **T Th & F** 11:00 – 12:00 (ETK)  
**T Th** 10:00 – 11:00 (CGG)

**Laboratory:** A hardcover bound Laboratory Notebook is required for all lab records. You are required to read and prepare the appropriate materials from the Lab Manual before arriving to do an experiment. Introductory Lab Friday, Sept. 8th (read Introduction, Good Lab Practice exercise and Introduction to Metering Devices).

#### Evaluation:

Assignments	<b>5%</b>
Research Assign/Presentation	<b>10%</b>
Mid-Term Test	<b>15%</b>
Laboratory	<b>30%</b>
Final Exam	<b>40%</b>

*Students must pass both the lecture and laboratory independently in order to pass the course.*

# CHEMISTRY 311: ENVIRONMENTAL CHEMICAL ANALYSIS

## COURSE OUTLINE

### **Introduction and Review:** Chapters 0, 1 and 2 (1.5 weeks)

- Chemical Analysis – volumetric, spectrophotometric and electrochemical techniques
- Review: Significant Figures, Naming, Oxidation States, Acids/Bases, Electrochemistry
- Measures of Concentration (M, N, mg/L, ppm etc)
- Preparing solutions and more stoichiometry
- Tools of the trade

### **Environmental Analytes and Environmental Matrices:** Handouts and lecture notes (1.5 weeks)

#### *Standard Methods for the Analysis of Water and Wastewater*

- Physical, Chemical and Biological Parameters
- Solids, Inorganic Ions, Metals, Organics
- Dissolved Gases: Oxygen and Carbon Dioxide
- Oxygen Demand and Alkalinity
- Sample Preparation (digestions) and Sampling Methods (blanks, internal standards and preservatives)

### **Experimental Error and Applied Statistics:** Chapter 3 and 4 (1.5 week)

- Types of Error, Precision and Accuracy
- Propagation of uncertainty
- Gaussian distributions, Standard deviations, Confidence intervals
- Comparison of mean values and Q-test for data rejection
- Data handling, Spreadsheets and Control charts

### **Calibration Methods:** Chapter 5 (1.5 weeks)

- Best fit lines (linear regression)
- Calibration curves
- Standard Addition
- Internal Standards
- Spreadsheets for Least Squares Analysis

MID-TERM (Tentative Date Tuesday, October 18<sup>th</sup>)

### **Instrumental Methods** (6 weeks)

- Electrochemical Methods (pH, ISE and DO) Selections from Chapters 14, 15
- UV/Vis Spectrophotometry (and fluorimetry) Selections from Chapters 19, 20, 21
- Atomic Absorption Spectroscopy (AAS, AES) Chapter 22
- GC/HPLC (conventional and MS detectors) Selections from Chapters 23, 24, 25

### **Tandem Instrumental Methods and Emerging Technologies** (1 week)

- LC-MS
- GC-MS/MS
- Student Presentations (Special Topics)

*Your textbook is a powerful resource.*

*Use the index to supplement the lecture material and lab reports.*

*Familiarize yourself with the supplemental reference materials available in the library.*

## ENVIRONMENTAL CHEMICAL ANALYSIS 2017 LAB SCHEDULE CHEMISTRY 311

Sept. 8<sup>th</sup>      **Introduction to a Chemical Analysis Laboratory:** GLPs and Lab Reports.

**Introduction to Metering Devices** (pH, Turbidity, Conductivity and DO)  
Calibration, Precision and Data Reporting  
Data Tables                              **Due: Sept.15<sup>th</sup>**

Sept. 15<sup>th</sup>      **Alkalinity of Natural Waters**  
Volumetric Analysis  
Data, Calculations and Results Tables      **Due: Sept. 22<sup>th</sup>**

Sept. 22<sup>nd</sup>      **Carbon Dioxide in Air**  
Gravimetric Analysis and Back Titration  
Data, Calculations, and Results              **Due: Sept. 29<sup>th</sup>**

Sept. 29<sup>th</sup>      **Field Trip – TBA**  
Sample Collection/Field Analysis  
Assignment: Principle of Method, Data and Results      **Due: Oct. 6<sup>th</sup>**

Oct. 6<sup>th</sup>      **Dissolved Oxygen in Surface Waters**  
Winkler Titration (azide modification)  
Full Lab Report                              **Due: Oct. 18<sup>th</sup>**

Oct. 13<sup>th</sup>      **Nitrites/Nitrates in Drinking Water**  
Spectrophotometry/Calibration Curves  
Full Lab Report                              **Due: Oct. 25<sup>th</sup>**

Oct. 20<sup>th</sup>      **Ortho-Phosphates in Wastewater**  
Spectrophotometry/Standard Additions  
Full Lab Report                              **Due: Nov. 1<sup>st</sup>**

Oct. 27<sup>th</sup>      **Fluoride in Groundwater and Toothpaste**  
Ion Selective Electrode  
Full Lab Report                              **Due: Nov. 8<sup>th</sup>**

### Group Rotations Next Four Weeks (Two Week Labs)

Lab start dates: Nov. 3<sup>rd</sup> and Nov. 17<sup>th</sup>

Technical Reports (Data, Calculations and Results) due: Nov. 21<sup>st</sup> and Dec. 5<sup>th</sup>

Group I      **Heavy Metals in Sediment**  
Digestion, Atomic Absorption Spectroscopy

Group II      **Organic Contaminant Analysis**  
Sample Preparation, Chromatography/Internal Standards

***Full Lab and Technical Reports are due 11 calendar days following the completion of the lab. A late penalty of 10% per week applies for reports up to two weeks late, after which they will NOT be accepted.***

## *Policy on Cheating and Plagiarism*

Cheating and plagiarism are serious offences. There are many forms of cheating that are considered unacceptable methods of gaining credit. The overall objective to enforcing penalties for cheating and plagiarism is to prevent unjustified credit being obtained for work that is not one's own. The penalties for *attempting* to gain unjustified credit often appear harsh. 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 as 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 <http://csci.viu.ca/~liuh/AcademicGuidelines.html>

The notes below give typical chemistry lab examples of situations that may help to clarify the broader definitions given in the Calendar.<sup>1</sup>

- 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 an important 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**

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

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<sup>1</sup> Adapted from *University of Victoria, Chemistry 235 Laboratory Manual, 2003* with the author's permission.