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, web.viu.ca/krogh
Dr. Chris Gill, Bldg. 360-Rm306, local 2303, Email: chris.gill@viu.ca, web.viu.ca/gill

Online Resource for textbook http://www.whfreeman.com/qca8e

Supplemental Materials on Library Reserve:
Standard Methods for the Examination of Water and Wastewater, 21st ed., 2005
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]

Lab Manual: Available from Instructor.

Prerequisites:  CHEM 122  Recommended:  CHEM 213/221

Time and Location:  Lectures  8:30 – 9:20 T, Th  Bldg.380-Rm202
Laboratory  2:30-5:30 F  Bldg. 360-Rm201

Office Hours:  TBA (check office schedule)

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. 7th (read Introduction, Good Lab Practice exercise and Electrochemical Metering Devices).

Evaluation:
Assignments  8%
Research Assign/Presentation  10%
Mid-Term Test  12%
Laboratory  30%
Final Exam  40%

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 (2 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 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 16th)

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 Seminars on 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
2011 LAB SCHEDULE CHEMISTRY 311

Sept. 7th  Introduction to a Chemical Analysis Laboratory: GLPs and Lab Reports.

Introduction to Metering Devices (pH, Turbidity, Conductivity and DO meters):
Calibration, Precision and Data Reporting
Data Tables due: Sept.13th

Sept. 14th  Alkalinity of Natural Waters
Volumetric Analysis
Data, Calculations and Results Tables due: Sept. 20th

Sept. 21st  Carbon Dioxide in Air
Gravimetric Analysis and Back Titration
Data, Calculations, Results and Discussion due: Sept. 27th

Sept. 28th  Field Trip – TBA
Sample Collection/Field Analysis
Principle of Method, Data and Results due: Oct. 4th

Oct. 5th   Dissolved Oxygen in Surface Waters
Winkler Titration
Full Lab Report due: Oct. 16th

Oct. 12th  Nitrites/Nitrates in Drinking Water
Spectrophotometry/Calibration Curves
Full Lab Report due: Oct. 23rd

Oct. 19th  Ortho-Phosphates in Wastewater
Spectrophotometry/Standard Additions
Full Lab Report due: Oct. 30th

Oct. 26th  Fluoride in Groundwater and Toothpaste
Ion Selective Electrode
Full Lab Report due: Nov. 6th

Group Rotations Next Four Weeks (Two Week Labs)
Lab start dates: Nov. 2th and Nov. 16th
Full Reports due: Nov. 15th and Nov. 29th

Group I  Heavy Metals in Sediment
Digestion, Atomic Absorption Spectroscopy

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

Full Lab 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 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](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.

- 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.

VII Grade Scale

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<tr>
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1 Adapted from University of Victoria, Chemistry 235 Laboratory Manual, 2003 with the author’s permission.