**Chemistry/Geology 1660- Instrumental Analysis with Environmental Applications**

Instructors: William Suggs (GC 451) and David Murray (MM 114)

Teaching Assistant: Bo Shen (GC 332)

**Course description:** This course covers the principles and practical applications of important analytical chemistry tools used to study environmental problems, including discussions of method selection and statistical treatment of data. Students will strategize and implement a study of a chemically contaminated site. Includes lab sessions with hands-on experience of instrumental analysis using atomic and molecular spectroscopic techniques, separations by gas and liquid chromatography, and electrochemical methods.

**Pre-requisites**: CHEM0330, or GEOL1370, or permission of instructor

**Primary Lecture**: T, Th 10:30-11:50 AM, MacMillan Room 101

**Laboratory Session**: Thursday 2-5 PM room GeoChem 150; Friday 1-4 PM, MacMillan 101.

**Topics**: Theory of analysis and measurement; atomic spectroscopy, UV/Fluorescence, separation by HPLC and GC, mass spectrometry, electrochemical analysis; final project covering sampling plan, sampling, analysis and data synthesis of a local chemically contaminated site.

**Text:** D A Skoog, F J Holler, S R Crouch, *Principles of Instrumental Analysis* 6th Ed, Brooks Cole. ISBN: 978-0-495-01201-6

**Accommodations:** Provide the instructor with a copy of the documents from Disability Support Services (DSS) during the first two weeks of class. If you have a circumstance that may impact your ability to do work for this class, you have *the first two weeks* of class to notify the instructor *in advance* and in writing.

**Academic Honesty:** The highest standard of academic honesty and integrity is expected. Penalty for cheating and copying of any sort is an automatic NC and report to the Dean.

See <http://www.brown.edu/Administration/Dean_of_the_College/academic_code/>

**Learning Outcomes**

1) Improved ability to develop/design best strategies to solve real-world problems using chemical analysis

2) Understand strengths, limitations of key analytical instruments, learn to interpret data effectively and accurately; understand important approaches for statistical treatment of data

3) Comprehend the fundamental principles behind major categories of instrumental analysis (spectroscopy, chromatography, electrochemistry, mass spectroscopy)

4) Gain experience in operating modern instrumentation for chemical analysis

5) Synthesize results into coherent poster and written presentation

6) Summarize lab exercises with written lab reports

7) Reflect on learning process and skills learned.

**Format**: For the first 10-11 weeks, there will be lectures giving the physical and chemical basis of analytical techniques. There will be five labs using instruments to cover four broad categories in analytical chemistry, and an introductory lab session related to the contaminated site to be studied for the class project. For each analytical lab there will be a prelab (approximately 30 minutes) where the week’s lab exercise is described.

**Grading**

Assessments (3): 30%

Lab Reports: 40%

Homework: 5 %

Project: 25 %: Team proposal (5%), peer review of another group’s proposal (5%), group presentation – **team** (5 %), final report- **individual** (10%))

**Lecture and Basic Laboratory Schedule**

Homework assignments or worksheets may be assigned in class for specific topics.

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| --- | --- | --- | --- | --- |
| **Date** | **Lecture topic** | **Lab** | **Reading Assignment** | **Assignment**  **Due** |
| 1/22 | Introduction to the course | ---- | Chapter 1 | --- |
| 1/27 | Emission and Absorption Spectroscopy | --- | Chapter 6 | --- |
| 1/29 | Waste Management and  Background on study site |  | See Canvas for websites | ---- |
| 2/3 | Atomic Spectroscopy |  | Chapters 8 & 9 |  |
| 2/5 | Atomic spectroscopy |  | Chapters 10 & 12 |  |
| 2/5,6 |  | Lab 0- Instrumentation and discussion of planned analyses | See Canvas for documents | Come prepared to discuss analyses at study site |
| 2/10 | Atomic spectroscopy |  | Chapters 10 & 12 |  |
| 2/12 | Molecular spectroscopy |  | Chapters 13 & 14 |  |
| 2/12,13 |  | Lab 1: Atomic Spectroscopy | See Canvas for documents | Lab Exercise 1 |
| 2/17 | Holiday-no class |  |  |  |
| 2/19 | Molecular Spectroscopy |  | Chapters 13 & 14 | Assessment 1  (in-class) |
| 2/24 | Molecular spectroscopy |  | Chapters 15 & 16 |  |
| 2/26 | Electrochemistry |  | Chapter 22 |  |
| 2/26,27 |  | Lab 2: Reflectance Spectroscopy | See Canvas for documents | Report for Lab 1 |
| 3 /3 | Electrochemistry |  | Chapter 22 |  |
| 3/5 | Electrochemistry |  | Chapter 23 |  |
| 3/5,6 |  | Lab 3: Electrochemistry | See Canvas for documents |  |
| 3/10 | Electrochemistry |  | Chapters 24 & 25 |  |
| 3/12 | Chromatography |  | Chapter 26 | Assessment 2  (in-class) |
| 3/12,13 |  | Background & Discussion of Study Site |  | Report for Lab 2 |
| 3/17 | Chromatography |  | Chapter 27 |  |
| 3/19 | Chromatography |  |  |  |
| 3/19,20 |  | Lab 4: Gas Chromatography | See Canvas for documents | Report for Lab 3,  Group proposal for sampling & analysis due |
| 3/21-3/29 | Spring break |  |  |  |
| 3/31 | Chromatography |  | Chapters 27 & 28 |  |
| 4/2 | Chromatography |  | Chapter 28 |  |
| 4/2,3 |  | Lab 5: Liquid Chromatography | See Canvas for documents | Report for Lab 4 |
| 4/7 | Mass Spectrometry |  | Chapters 20 & 21 |  |
| 4/9 | Mass Spectrometry |  | Chapters 20 &21 |  |
| 4/14 | Assessment 3 |  |  | (in-class) |
| Week of 4/13 | Field trip to Study Site |  |  |  |
| 4/17 |  |  |  | Report for Lab 5 |

**Semester Project Schedule**

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| Bench Marks for Project | Dates | Assignment |
| 1 | 2/5,6 | Individual ideas for analytical component of project, preliminary groupings |
| 2 | 3/12,13 | Background & Discussion of Study Site |
| 3 | 3/20 | Group proposal for sampling and analysis |
| 4 | 4/10 | Peer Review of Group Proposals due |
| 5 | Week of 4/13 | Field work and start analytical work |
| 6 | Week of 4/20 | Analytical work |
| 7 | Week of 4/27 | Analytical work & synthesis of results |
| 8 | 5/5 | Group presentation during lecture time |
| 9 | 5/14 | Final paper due (5 PM) |