Chemistry 312 Principles of Instrumental Analysis Spring 2007

Instructor: **Dr. Chris Gill**: **B360 - Rm. 306**, 753-3245 ext. 2303, **gillc@mala.bc.ca**

Office Hours: T. Th. 11:30 - 12:30 AM, other times by appointment

Text: D. A Skoog, F. J. Holler, T. A. Niemann, "Principles of Instrumental Analysis", Thompson, Brooks, Cole, 6th Edition, 2007.

Description: This is an instrumental analysis chemistry course, designed to examine the theory and principles of chemical analysis. Topics include classical and current analytical methods, with an emphasis on instrumental techniques.

Prerequisite: minimum of "C-" in Chem 311

Transferability: Equivalent to UBC Chem 311 "Instrumental Analysis"

Grading Scheme:

Research Project	10%
Laboratory	30%
Mid-term Test	20%
Exam	40%
Total	**100%**

Week	Topic	
1	Chemical analysis and decision making, role of Instrumental analysis,	Chapter 1
	analytical figures of merit, the ideal analytical instrument	
	Signal transducers and chemical measurements, statistical treatment of	Chapter 1
	experimental data, signals and noise, detection limit	Chapter 5
2	Introduction to electrochemical methods of analysis - Nernst equation,	Chapter 22
	Electrochemical cells, Direct potentiometry	
3	ISE and Potentiometric Methods, Polarography and Voltammetry	Chapter 23, 25
4	Optical spectroscopic methods of analysis - Fundamentals	Chapter 6
5-6	Instrumentation in optical spectroscopy	Chapter 7
5-6	Atomic Spectroscopy - origin of spectra, high temperature equilibria	Chapter 8
	Atomic emission and absorption spectroscopy	Chapter 9
7-8	Plasma spectroscopy - ICP's, arcs, sparks	Chapter 10
	UV-VIS absorption, luminescence spectrophotometry	Chapter 13 - 15
	IR and Raman Spectroscopy	Chapter 16 - 18
9	Radiochemical methods of analysis - Introduction, radiocarbon dating	Chapter 32
	Instrumental neutron activation analysis, isotope dilution	Chapter 32
10	Mass spectrometry - Ionization sources, mass analyzers, detectors	Chapter 20
	Mass spectrometry - Current trends	Chapter 20
11	Chromatography and Separation Science - Introduction	Chapter 26
	Principles of chromatographic separations, columns	
12	GC & LC - instrumentation and applications, GC-MS, LC-MS	Chapter 27, 28

13	Other separation methods {electrophoresis, supercritical fluid chrom}	Chapter 30
	Automation, Flow injection, robotics	
	Surface Analysis: X-Ray spectroscopy, ESCA, Auger, SIMS	Chapter 12 and 21

Laboratory: The Laboratory for this course is divided into two components:

Part I: Instrumental Technique: In this portion of the lab **(6 weeks)** you will be exposed through organized experiments to instrumental methods from representative analytical instrumentation, including separation methods (GC, HPLC), optical methods (UV-Vis, AAS) electrochemistry (NH_3 ISE) and mass spectrometry (GC-MS). In each of these experiments, you will examine phenomena related to the various methods, including interferences, instrumental optimization and calibration. The emphasis is upon understanding the instrumentation and its effective use for chemical measurement. These labs will be submitted as partial reports involving data analysis and a referenced discussion of the results / instrumental phenomena being studied. **(15%)**

Part II: Analytical Project: In this portion of the lab **(6 weeks)**, you will be expected to design and implement the chemical measurement of an analyte in a real sample. The following instrumental methods may be used* (AAS/AES, UV-Vis, GC-(FID, TCD, MS), HPLC-(UV, EC), ISE (F-, NH3, pH), RFA, Spectrofluorimeter, IR). In each case, you will be required to design the experiment and sample preparation, optimize the analytical conditions required for successful analyses, and validate your experimental measurements (i.e. calibration, SRM etc.). **Do not underestimate the time required for this project**. **START EARLY. Let me re-emphasize: start early.** You will be required to submit a detailed formal, final report outlining your project, including a well defined procedure and results section. **(15%)**

*subject to instructor approval and/or availability

***Analytical Project Timelines*:**

Jan. 26th Pre-proposal (Title, 1 page max)
Identify method, analyte, sample prep
Feb. 16th Proposal (2-4 pages max)
Introduction, detailed procedure, equipment list, reagents, anticipated timelines for work
April 13th (Friday) Final Report Due

Research Project: This will be an academic poster presentation explaining an analytical (instrumental) method. A standard poster board format is required (30" high by 40"- 60" wide) and you are expected to follow the poster presentation guidelines established by the American Society for Mass Spectrometry. Do not use the instrumentation used for your Analytical Project for your Research Project. **Written topic proposals will be approved first come, first served.**

***Research Project Timelines*:**

Jan 26th Proposal
April 6th Poster Due

Laboratory Reports: **Word Processing is required**

Report Outline

Laboratory Title

Objective: Restate in your own words (one or two sentences)
Procedure: as appropriate (i.e. detailed for project)
Chemical Reaction(s): include **relevant balanced chemical reactions**
Principle of Method: explain the underlying principles & instrumental method(s) and sample preparation(s) used.

Calculations & Results: **neat, labelled data tables & figures**
neat calculations (can be hand written)
result(s) with uncertainty values

Discussion: a brief discussion of the method, its advantages and limitations, historical importance, sources of error, possible chemical interferences, alternative analyses, **with cited references**. (~2 pages, ACS Endnote Reference Format).

Conclusion: Should answer the question: "Did you achieve the objective?". A re-statement of the any results is also appropriate. Summarize your data with tables. (~1 paragraph)

References: 3+ references, in ACS (American Chemical Society) format

Uncertainty Values: Report uncertainty on any quantitative measurements to a 95% confidence interval.
Note: report only one significant figure for uncertainty values.

Plagiarism: The inappropriate and/or un-referenced use of websites, books, journals and other published and un-published materials is not acceptable and is subject to academic penalty. Refer to **"Procedure 99.01.00"** of the **"**Student Academic Code of Conduct" on the Malaspina home page for additional information.

Letter Grade Scheme:

Percent	Letter	Grade Pts.	Percent	Letter	Grade Pts.
90-100	A+	10	65-69	C+	4
86-89	A	9	60-64	C	3
82-85	A-	8	55-59	C-	2
78-81	B+	7	50-54	D	1
74-77	B	6	<50	F	0
70-73	B-	5			