

**UNIVERSITY OF CALGARY**  
**DEPARTMENT OF CHEMISTRY**  
**COURSE SYLLABUS**  
**FALL 2017**

COURSE: CHEM 311, ANALYTICAL CHEMISTRY: QUANTITATIVE ANALYSIS

LEC	DAY & TIME	ROOM	INSTRUCTOR	OFFICE	EMAIL	OFFICE HOURS
L01	Tue & Thu 12:30-1:45	CHC 105	Dr. A. Musgrove Richer	SA 144F	<a href="mailto:amanda.musgroveriche@ucalgary.ca">amanda.musgroveriche@ucalgary.ca</a>	TBA

Formal office hours will be posted; appointments may also be requested by email or via <https://doodle.com/musgrove>

To help me reply faster, please put "CHEM 311" in the subject line of any email correspondence.

#### TEXTBOOK

*Quantitative Chemical Analysis*, 9<sup>th</sup> Ed.; Daniel C. Harris, 2016, W.H Freeman and Company.

Older editions are acceptable; however it is the students' sole responsibility to ensure that s/he can identify the appropriate chapter readings and practice problems in alternate texts.

#### TOPICS INCLUDED AND SUGGESTED TEXTBOOK READINGS

Students are responsible for all material included in lectures *and* laboratories. Some material may not be addressed directly in lecture, but will be discussed in laboratory or in the assigned readings and assignments. All suggested readings below reference the recommended textbook (Harris 9<sup>th</sup> Ed.).

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#### TOPIC 1: INTRO TO ANALYTICAL CHEMISTRY

Chapter 0: The Analytical Process  
Chapter 1: Measurements  
Chapter 2: Tools of the Trade

AFTER STUDYING THIS TOPIC, YOU SHOULD BE ABLE TO:

- Explain the general principles of quantitative analysis
- Identify common analytical methods and equipment, and describe their correct usage

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#### TOPIC 2: UNCERTAINTY AND ERROR ANALYSIS

Chapter 3: Experimental Error  
Chapter 4: Statistics (4.1-4.6)

AFTER STUDYING THIS TOPIC, YOU SHOULD BE ABLE TO:

- Identify sources of uncertainty in chemical measurements
- Use appropriate statistical techniques to describe and quantify the uncertainty in chemical measurements

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#### TOPIC 3: QUANTITATIVE ANALYSIS: EQUILIBRIUM AND TITRATIONS

Chapter 6: Chemical Equilibrium  
Chapter 7: Let the Titrations Begin  
Chapter 8: Activity and the Systematic Treatment of Equilibrium  
Chapter 9: Monoprotic Acid-base Equilibria  
Chapter 10: Polyprotic Acid-base Equilibria  
Chapter 11: Acid-base Titrations  
Chapter 12: EDTA Titrations

AFTER STUDYING THIS TOPIC, YOU SHOULD BE ABLE TO:

- Use equilibrium principles to quantitatively describe the composition of solutions:
  - Monoprotic and polyprotic acids and bases
  - Metal ions with chelating reagents
  - Sparingly soluble compounds
- Describe (qualitatively and quantitatively) the changes that occur in these solutions during a titration
- Explain and apply important titration techniques, including: endpoint detection, back titration, masking interferants

## LABORATORY EXPERIMENTS (3 + 7, 10 WEEKS)

### “TRAINING CAMP”

*3 weeks of hands-on skill development*

### ANALYSIS FOR SODIUM CARBONATE

*Standardization, primary standards, acid-base titrations*

### ANALYSIS OF AN ACID MIXTURE

*Potentiometric (pH) titrations, acid-base titrations, correcting for non-removable impurities*

### DETERMINATION OF SOLUBLE CHLORIDE

*Volhard titration, Back titration, precipitation, filtration, argentometric titration*

### ANALYSIS FOR COPPER IN BRASS

*Iodometric titration, sample preparation, alternation of analyses*

### DETERMINATION OF ETHYLENE GLYCOL BY FUNCTIONAL-GROUP ANALYSIS

*Redox titration, primary standards*

### DETERMINATION OF NTA IN DETERGENT BY POTENTIOMETRIC TITRATION

*Potentiometric titration, ion-selective electrodes, Gran plots, surfactant analysis*

### ANALYSIS OF CALCIUM IN LIMESTONE BY COMPLEXIMETRIC TITRATION

*EDTA titration, complexation reactions*

WHILE COMPLETING THE LABORATORY COMPONENT, YOU WILL:

- Develop hands-on lab skills and the ability to perform chemical manipulations with high precision and accuracy.
- Determine the most relevant sources of uncertainty/error in analytical techniques.
- Demonstrate appropriate record-keeping by keeping a lab notebook that conforms to professional and ethical standards.

## ASSIGNMENTS

There are 5 assignments in this course. **Assignments 1-4** are “hybrid” assignments, where you will submit some answers via D2L, and some written work on paper for grading. Written work should be submitted to the blue dropboxes outside SA 116 (organized by lab section) before 3 PM on the due date. *Instructions and due dates for these assignments are available on the course D2L site.* Each assignment will have questions reflecting approximately the previous two weeks of course content.

**Assignment 5** is an ongoing online assignment to be completed throughout term. This assignment uses the PeerWise question generation platform. For this assignment, you will create exam-style multiple choice questions, and rate and review the questions of your classmates. You will be graded based on the completion of the assignment requirements and the quality of your submissions. *Full details are posted on the course D2L site.* The assignment will be graded in two parts:

PART 1: Due Oct 27 (submission), Nov 1 (review)      PART 2: Due Dec 2 (submission), Dec 8 (review).

The **in-class Top Hat** practice questions will be graded based on a combination of participation and correctness. If you choose to participate, your average Top Hat score for the semester can *replace your lowest non-zero assignment score* if doing so benefits your grade overall. This will be done automatically for all students – make sure your UCID and @ucalgary.ca email are updated in your Top Hat account so your grades can be linked.

*All Top Hat grades will be pro-rated to allow for 3-4 classes “free” – if you are ill, unable to attend, or have a tech failure for a couple days, these be covered in the “free” days. If you are unable to participate for longer, contact your instructor to make alternate arrangements.*

TENTATIVE LECTURE & LABORATORY SCHEDULE

Week Starting:	Schedule for Lecture Topics (Tentative - Subject to Change)	Lab Schedule
September 11	Introduction Analytical Process, Experimental Error	No labs
September 18	Experimental Error Statistics	Check-in Training Camp 1
September 25	Statistics	Training Camp 2
October 2	Statistics Equilibrium <b>Ass't 1 Due</b>	Training Camp 3
October 9 <i>Thanksgiving: Oct. 9</i>	Titrations	Carbonate <b>Note: B01</b> will have an evening make-up this week (time TBA).
October 16	Activity & Systematic Treatment of Equilibrium <b>Ass't 2 Due</b>	Acid Mix
October 23	Activity & Systematic Treatment of Equilibrium Monoprotic Acids & Bases	Volhard
October 30	<b>Midterm: Thurs Nov 2, 12:30-1:45 (in-class)</b> Monoprotic & Polyprotic Acids and Bases	Brass
November 6 <i>Reading Days: Nov 10-13</i>	Polyprotic Acids and Bases	Section <b>B01 only</b> : Glycol (B02-B08: No lab)
November 13 <i>Reading Days: Nov 10-13</i>	Acid-Base Titrations <b>Ass't 3 Due</b>	Glycol ( <b>B01</b> : No lab)
November 20	Acid Base Titrations	NTA
November 27	EDTA Titrations <b>Ass't 4 Due</b>	Limestone
December 4	EDTA Titrations <b>Ass't 5 Completion</b>	Check-out

*Assignments 1-4 are due to D2L and/or the dropbox outside SA 116 before 3 PM on the announced due date. (see D2L)*

*Classes End: Dec 8*

*Final Exam Period: Dec. 11 - 21*