

**CHEM 2400/2480 Analytical Chemistry I (Fall 2017)**  
**University of Guelph**  
**Department of Chemistry**  
**Course Outline**

**Course Description:** This course introduces fundamental concepts and principles of classical analytical chemistry and focuses on the quantitative analysis of important chemical species in aqueous and solid samples by volumetric, gravimetric, electrochemical and spectrophotometric techniques. The course is intended to build the foundation of good analytical laboratory practice and provide students with an understanding of all aspects of chemical analysis, including solution equilibria and data analysis using spreadsheet applications.  
Credit weighting = 0.75 (CHEM 2400), 0.50 (CHEM 2480).

**Prerequisites:** CHEM 2400: **CHEM 1050** CHEM 2480: **CHEM 1050** or **CHEM 1310**

**Instructor:** Dr. Wojciech Gabryelski, SSC 1248, ext. 53850

**e-mail:** wgabryel@uoguelph.ca

**Lectures:** Mondays, Wednesdays and Fridays 12:30 - 1:20 p.m., MCLN 102.

**Office hours:** Tuesdays, Wednesdays and Fridays 1:30 - 4:30 p.m. Please feel free to come to see me for help at any time when you need it.

**Lab Coordinator:** Dr. Kate Stuttaford, SSC 3113A, ext. 53382, kstuttaf@uoguelph.ca

## **1. COURSE MATERIALS**

**Required:** D.C. Harris, "Quantitative Chemical Analysis", 9th ed., W.H. Freeman and Company, New York, USA, (2016) and solutions manual (on reserve at the library)

CHEM 2400/2480 Lab Manual (may be purchased for \$10 from the chemistry department at the start of the semester).

**Other materials:** D.C. Harris, "Quantitative Chemical Analysis", 8th ed. (2010) or 7th ed. (2006), W.H. Freeman and Company, New York, USA.

Lecture notes, problem sets, spreadsheets applications and other useful information will be available through the course website.

## 2. EVALUATION

**Grading:** The course grade will be calculated based on the scheme below:

	<b>CHEM 2400</b>	<b>CHEM 2480</b>	<b>Date</b>
Midterm	25%	30%	Monday, October 23rd, 12:30-1:20 p.m., (in class)
Final Exam	25%	30%	Thursday, December 7th, 2:30-4:30 p.m., Room TBA
Laboratory	50%	40%	

**IMPOTRANT!** To get credit for the course, passing grades (50% or higher) must be obtained on both the laboratory AND the lecture components of the course; failure to achieve both will result in a reported mark no higher than 48%.

**Missed Midterm Examination:** If you do not write the midterm, documentation must be given to your instructor. If a valid excuse is received (doctor's notes are always acceptable), a make-up midterm examination will be given.

**Missed Final Examination:** If you miss a final exam, contact your Program Counselor as soon as possible (refer to [www.uoguelph.ca/uaic/programcounsellors](http://www.uoguelph.ca/uaic/programcounsellors) for a list of Program Counselors). Official documentation is required. Consult the Undergraduate Calendar (Section VIII, under Academic Consideration).

## 3. COURSE CONTENT (Lectures)

### 1. Chemical Measurements and Analytical Tools

- Chemical concentrations and stoichiometry calculations (Chapter 1)
- Experimental Error (Chapter 3)
- Statistical evaluation of analytical data (Chapter 4)
- Quality assurance, calibration methods and spreadsheets (Chapter 5)

### 2. Chemical Equilibria

- Ionization of water (Chapter 6)
- Strengths of acids and bases (Chapter 6)
- Relation between  $K_a$  and  $K_b$  (Chapter 6)
- Systematic treatment of equilibrium (mass and charge balance) (Chapter 8)

### 3. Acids and Bases

- Monoprotic acid-base equilibria (Chapter 9)
- Buffers (Chapter 9-5)
- Polyprotic acid-base equilibria (Chapter 10)
- Acid-base titrations (Chapter 11)

### 4. Solubility Equilibria

- Solubility product  $K_{sp}$  and complex formation (Chapter 6-3 and 6-4)
- Solubility and pH (Chapter 13-3)
- Precipitation titrations (Chapter 7)

- Gravimetric analysis (Chapter 27)

### 5. Complexometric Titrations

- Metal-chelate complexes (Chapter 12-1)
- EDTA titration techniques (Chapter 12)

### 6. Electrochemistry

- Electrodes and potentiometry (Chapter 15)
- Ion selective electrodes (Chapter 15-4)
- Red-ox titrations (Chapter 16)

*Each section of lectures (1-6) is approximately two weeks in duration.*

## 4. LABORATORY

**Lab Description:** CHEM 2400/2480 labs provide an opportunity to learn and understand practical aspects of classical chemical analysis which is commonly applied in many experimental disciplines such as life and environmental sciences. Lab experiments in CHEM 2400/2480 include the quantitative analysis of bicarbonate, potassium hydrogen phthalate, iron, calcium, magnesium copper, oxalate and chloride in aqueous solutions and solid samples (soda ash and copper ore) using acid-base, EDTA, precipitation and red-ox titrations as well as gravimetric analysis and UV absorption spectroscopy. Students perform the calibration of volumetric glassware, electronic and analytical equipment as well as statistical evaluation of analytical data including linear regression analysis and constructing a calibration curve from a given analytical data set using spreadsheet software. **The lab coordinator (Dr. Kate Stuttaford) uses the CourseLink website for lab discussion groups and for posting lab grades and other information relevant to lab regulations and activities.**

**Lab Activities:** The labs are scheduled for Monday/Tuesday/Wednesday/Thursday afternoons 2:30 to 5:20, Tuesdays/Thursdays mornings 8:30 to 11:20 and Tuesday/Thursday evenings 7:00 - 9:50 in 3103 SSC and 3104 SSC. Laboratories in CHEM 2400 consist of two three-hour labs per week. Laboratories in CHEM 2480 consist of one three-hour lab per week. Students attend their laboratories according to their lab sections in which they are registered. There are seven teaching assistants/lab supervisor in the course (Micaela Gray, Hart Slater-Eddy, Ielizaveta Poloz, Nathan Shami, Kayla Harnden, Tadeu de Cunha and Delaney Armstrong-Price). Each TA will set office hours for his/her group of students to answer laboratory related questions. **CHEM 2400 and CHEM 2480 labs start in the week of September 11th.** For the first introductory lab, each student should bring **the lab manual, a hard-bound lab notebook, a lab coat, a breakage card** (available at lab manual sales), **goggles and closed shoes** (not sandals). Students should be prepared to work the entire lab period (3 hours). The laboratory manual can be purchased (cash only) from the Chemistry Department in SSC 2106 on weekdays (9:30 am to 3:30 pm) from September 8<sup>th</sup> to September 13<sup>th</sup>.

## **5. UNIVERSITY POLICIES**

### **E-mail Communication**

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

### **When You Cannot Meet a Course Requirement**

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor in writing, with your name, id#, and e-mail contact. See the undergraduate calendar for information on regulations and procedures for Academic Consideration:

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

### **Drop Date**

The last date to drop one-semester courses, without academic penalty, is **Friday, November 3rd, 2017**. For regulations and procedures for Dropping Courses, see the Undergraduate Calendar:

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml>

### **Copies of out-of-class assignments**

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

### **Accessibility**

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability or a short-term disability should contact the Centre for Students with Disabilities as soon as possible.

For more information, contact CSD at 519-824-4120 ext. 56208 or email [csd@uoguelph.ca](mailto:csd@uoguelph.ca) or see the website: <http://www.uoguelph.ca/csd>

### **Academic Misconduct**

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their

location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The Academic Misconduct Policy is detailed in the Undergraduate Calendar: <http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>

### **Recording of Materials**

Presentations which are made in relation to course work-including lectures-cannot be recorded or copied without the permission of the presenter, whether the instructor, a classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

### **Resources**

The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs:

<http://www.uoguelph.ca/registrar/calendars/index.cfm?index>