CHEM 3430 Analytical Chemistry II (Winter 2020)
University of Guelph
Department of Chemistry
Course Outline

Course Description: CHEM 3430 Analytical Chemistry II (3-3) [0.50] is designed to introduce students to modern methods of instrumental analysis in analytical chemistry. The focus of the course is on trace analysis, and therefore methods for the identification, separation and quantification of trace substances in solids, liquids and vapors will be described. The course is intended to build the foundations of good laboratory practice with good understanding of new concepts and principles of instrumental chemical analysis.

Prerequisites: CHEM 2400 or 2480 and CHEM 2070

Exclusions: TOX 3300

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

Email: wgabryel@uoguelph.ca

Lectures: Mondays, Wednesdays and Fridays from 12:30 to 1:20 p.m. in MCKN 237

Office hours: Mondays and Wednesdays 2:00 - 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

Lab. TAs: Scott Prins (prinss@uoguelph.ca) and Allyson Yee (ayee01@uoguelph.ca)

1. COURSE MATERIALS

Textbook: **(required)** D.C. Harris, "Quantitative Chemical Analysis", **9th ed**. (2016), W.H. Freeman and Company, New York, USA, and Solution Manual for this book (Total cost ~360 CAD$).
I will put one copy of each on reserve in our library.

Lab. Manual: **(required)** Lab. Manual for CHEM 3430 may be purchased from the chemistry department at the start of the semester. **You will need the lab manual for the introductory laboratory session during the week of January 6th.**

Other materials: **(supplementary textbook)** D.A. Skoog, F.J. Holler, S.R. Crouch, "Principles of Instrumental Analysis", **6th ed**. (2007), Thomson-Brooks/Cole Belmont, CA.

D.A. Skoog, F.J. Holler, T.A. Nieman, "Principles of Instrumental Analysis", **5th ed.** Call number KQ79.I5.S58. *(There are three copies of the book in the library for a two week loan)*

Course outline, lecture notes, problem sets, exam examples and other useful information will be available through the CourseLink website.

2. EVALUATION

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

Midterm	30%	February 26th
Final Exam	40%	April 18th
Laboratory	30%	

The midterm exam will be held on **Wednesday, February 26th** during the class hours.

The final exam will be on **Tuesday, April 7th** 8:30 - 10:30 AM (Room TBA)

IMPORTANT! 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 results 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 for a list of Program Counselors). Official documentation is required. Consult the Undergraduate Calendar (Section VIII, under Academic Consideration).

3. COURSE CONTENT (Analytical Techniques)

1. Instrumental Analysis
2. Atomic Absorption and Atomic Emission Spectroscopy
3. Molecular Spectroscopy
4. Introduction to Separation Methods
5. Gas Chromatography
6. Liquid Chromatography
7. Electrophoresis and field separations
8. Mass Spectrometry
9. Electrochemical Analytical Methods
10. Ion Selective Electrodes and Biosensors

Each section of lectures (1-10) is approximately one week in duration.

4. COURSE CONTENT (Lectures)

1. Instrumental Analysis (Introduction)
1.1. Goals of the Course,
1.2. Process of Chemical Analysis
1.3. Classification of Analytical Methods (Instrumental and Classical)
1.4. Objectives of Chemical Analysis
1.4. Instrumental Analytical Methods and Signal Transducers
1.5. Criteria for Optimal Selection of Instrumental Methods in Chemical Analysis
1.6. Specificity, Selectivity and Interferences in Chemical Analysis
1.7. Figures of Merit in Quantitative Instrumental Analysis (Accuracy, Precision, Sensitivity, Dynamic Range, Detection Limits)
1.8. Calibration of Instruments

2. Atomic Spectroscopy
2.1. Introduction to Optical Atomic Spectrometry
2.1.1. Optical Atomic Spectra (Absorption and Emission of Electromagnetic Radiation)
2.1.2. Atomization Methods
2.1.3. Sample-Introduction Methods
2.1.4. Optical Atomic Spectroscopy Instrumentation (Monochromators and Detectors)
2.2. Atomic Absorption Spectroscopy
2.2.1. Light Sources (Hollow Cathode Lamp)
2.2.2. Flame Atomic Absorption Techniques
2.2.3. Graphite Furnace Atomic Absorption Techniques
2.2.4. Interferences in Atomic Spectroscopy

2.3. Atomic Emission Spectroscopy
2.3.1. Flame and Inductively Coupled Plasma Atomization and Excitation Sources
2.3.2. Sequential and Multichannel Atomic Emission Spectrometers
2.4. Applications of Atomic Absorption and Emission Spectroscopy
2.5. Analytical Molecular Spectroscopy

3. Separation Methods
3.1. Introduction to Chromatographic Separations
3.1.1. Migration Rates of Solutes in Elution Chromatography
3.1.2. Band Broadening and Separation Efficiency
3.1.3. Optimization of Separation Conditions in Column Chromatography
3.2. Gas Chromatography (GC)
3.2.1. Principles of Gas Chromatography
3.2.2. GC Columns and Stationary Phases (Retention Index and Mc Reynolds Constants)
3.2.3. Essential Components of GC systems (injectors and detectors)
3.2.4. Applications and Advances in GC
3.3. Liquid Chromatography (LC)

3.3.1. Scope of High Performance Liquid Chromatography (HPLC)
3.3.2. Separation Efficiency of LC Column
3.3.3. LC Instrumentation
3.3.4. Adsorption Chromatography
3.3.5. Partition Chromatography (normal and reversed phase HPLC)
3.3.6. Ion Exchange Liquid Chromatography
3.3.7. Size Exclusion Liquid Chromatography
3.4. Electroseparation Techniques
3.4.1. Capillary Electrophoresis
4.4.2. Gel Electrophoresis and Electrochromatography

4. Atomic and Molecular Mass Spectrometry
4.1. Introduction to Mass Spectrometry
4.2. General and Unique Features of Mass Spectra
4.3. Ionization Methods in Atomic and Molecular Mass Spectrometry
4.4. Mass Analyzers and Mass Spectrometry Detectors
4.5. Interfacing Mass Spectrometry with Separation Methods
4.6. Applications of Mass Spectrometry: GC-MS of Anabolic Steroids
4.7. Applications of High Performance Mass Spectrometry: Analysis of Drinking Water

5. Electroanalytical Chemistry
5.1. Introduction to Electroanalytical Chemistry
5.2. Potentiometry
5.3. Voltammetry
5.4. Amperomeric Sensors and Detectors

Each section of lectures (1-5) is approximately two weeks in duration.

5. LABORATORY

Lab Description: CHEM 3430 labs provide an understanding of practical aspects of selected instrumental analytical methods which are widely applied by scientists in the 21st century. Experiments in CHEM 3430 labs include the determination of nitrates in water using Ion-Selective Electrodes, the determination of acetaminophen in a tablet using Cyclic Voltammetry, the determination of calcium in a vitamin tablet using Atomic Absorption and Emission Spectroscopy, analysis of steroids by Gas Chromatography, analysis of analgesic compounds by Liquid Chromatography as well as comprehensive analysis of complex samples using Mass Spectrometry. Students learn how to calibrate analytical instruments and how to optimize their performance. **The lab coordinator (Dr. Kate Stuttaford) uses the CourseLink website for lab discussion groups and to post lab grades and relevant information about lab activities and regulations.**

Lab Activities: The laboratories in CHEM 3430 are scheduled for Monday, Tuesday or Wednesday from 2:30 to 5:20 PM in SSC 3105. The introductory labs are scheduled in the week of January 6th. For the introductory lab, each student **should bring the copy of**

the lab manual only (no need for lab coats or goggles during the intro lab). Attendance to the introductory lab is required and students are expected to stay for approximately one hour. During this time, you will meet your Teaching Assistant (TA), review lab safety procedures, be assigned a lab partner and get the schedule of experiments so you know which experiment to prepare for the next lab. TAs (Scott Prins and Allyson Yee) will set office hours for students to answer their lab related questions. The laboratory manual can be purchased from the Chemistry Department starting on January 6th. Signs are posted in the Science Complex directing students to the right place. The lab manuals are available as a cash only purchase.

6. UNIVERSITY POLICIES

E-mail Communication

As per university regulations, all students are required to check their UoG e--mail account (xxx@uoguelph.ca) 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

If required, the course must be dropped by the end of the last day of classes. Regulations and procedures for Dropping Courses are available in 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 promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.
When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required, however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to book their exams at least 7 days in advance, and not later than the 40th Class Day.

For more information, see: www.uoguelph.ca/sas

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