

CHMB16H3

TECHNIQUES IN ANALYTICAL CHEMISTRY

FALL 2017 COURSE SYLLABUS

Course Instructors

Kagan Kerman (Theoretical), e-mail: kagan.kerman@utoronto.ca

Office hours: Mondays 3-6 pm in EV502 (on the 5th floor of the new Environmental Science and Chemistry Building behind the Instructional Centre. Students can also email Dr. Kerman to make an appointment to meet in his office on the other days of the week.)

Ronald Soong (Practical), e-mail: ronald.soong@utoronto.ca

Office hours: TBA

Classroom: Mondays 9 am - 12 pm in SW128

WebOption will be available!

Required Text: Students are strongly encouraged to follow the lectures and the notes of the instructor for guidance in readings and problems from the following textbook: Quantitative Chemical Analysis, Daniel C. Harris, 9th Edition, Publisher: W. H. Freeman & MacMillan Education.

Strongly Recommended: Solutions Manual for Quantitative Chemical Analysis, 9th Edition, Daniel C. Harris Publisher: W. H. Freeman & MacMillan Education.

Note: Lecture topics include suggested sections and review problems from the textbook. Such material may be included on exams. Your textbook is also available online (link below) and in the UTSC Bookstore or the Reserves section of the UTSC Library.

<http://www.macmillanlearning.com/Catalog/product/quantitativechemicalanalysisninthedition-harris>

Course Topics

Sept. 11 Introduction to Analytical Chemistry

Learning objectives: Qualitative and Quantitative Analytical Chemistry

QCA 9th Edition Chapter 0, Sections 0-1 and 0-2

QCA 8th Edition, Chapter 0, Sections 0-2 and 0-3

Problems: 0-1, 0-2, 0-3, 0-4, 0-5 (same in the 9th and 8th Editions)

Sept. 18 Chemical measurements

Learning objectives: GLP, SOPs, preparation of solutions

QCA 9th Edition, Chapter 1, Sections 1-1, 1-2, 1-3, 1-5 and 1-6

QCA 8th Edition, Chapter 1, Sections 1-1, 1-2, 1-3, 1-5 and 1-6

Problems: 1-16, 1-21, 1-22, 1-24, 1-34, 1-35 (9th Edition)
1-15, 1-18, 1-19, 1-21, 1-32, 1-33 (8th Edition)

Reading: Chapter 2 Tools of the Trade is important for your practicals. Please, read it carefully!

Sept. 25 **Experimental Error**

Learning objectives: Significant figures, random and systematic errors, uncertainties, confidence intervals

QCA 9th Edition, Chapter 3, Section 3-1,3-2, 3-3, 3-4

QCA 8th Edition, Chapter 3, Sections 3-1,3-2, 3-3, 3-4

Problems: 3-1, 3-2, 3-3, 3-5, 3-10, 3-13 (same in the 9th and 8th Editions)

Statistics

Learning objectives: Regression coefficient, method of least squares, t Test, F Test, Q Test, precision and accuracy

QCA 9th Edition, Chapter 4, Sections 4-1, 4-2, 4-3, 4-4, 4-6, 4-7, 4-8

QCA 8th Edition, Chapter 4, Sections 4-1, 4-2, 4-3, 4-4, 4-6, 4-7, 4-8

Problems: 4-3, 4-14, 4-15, 4-22, 4-23, 4-24 (9th Edition)

4-3, 4-13, 4-14, 4-21, 4-22, 4-23 (8th Edition)

Reading: **Sample Preparation**

Learning objectives: Statistics of sampling, sample preparation techniques

QCA 9th Edition, Chapter 28, Sections 28-1 (28-2 and 28-3 Reading only)

QCA 8th Edition, Chapter 27, Sections 27-1 (27-2 and 27-3 Reading only)

No recommended problems!

Oct. 2 **Quality Assurance and Calibration Methods**

Learning objectives: Standard addition, calibration curves, validation

QCA 9th Edition, Chapter 5, Sections 5-1, 5-2, 5-3, 5-4

QCA 8th Edition, Chapter 5, Sections 5-1, 5-2, 5-3, 5-4

Problems: 5-6, 5-8, 5-18, 5-19, 5-23, 5-30 (9th Edition)

5-6, 5-8, 5-18, 5-20, 5-24, 5-30 (8th Edition)

Oct. 9 THANKSGIVING DAY

Oct.16 **Acid-Base Titrations**

Learning objectives: Volumetric titrations between acids and bases

QCA 9th Edition, Chapter 11, Sections from 11-1, 11-2, 11-3, 11-4, 11-5, 11-6

QCA 8th Edition, Chapter 10, Sections 10-1, 10-2, 10-3, 10-4, 10-5, 10-6

Problems: 11-11, 11-18, 11-24, 11-29, 11-31, 11-47 in the 9th Edition

10-11, 10-18, 10-24, 10-29, 10-47 in the 8th Edition

Oct. 23 MID-TERM-1: Mid-term-1 will contain multiple-choice and short-answer questions. The exam will cover the topics from the beginning until the end of “Acid-base titrations”.

Oct. 30 **Fundamentals of Electrochemistry**

Learning objectives: Nernst Equation

QCA 9th Edition, Chapter 14, Sections 14-1, 14-2, 14-3, 14-4, 14-5, 14-6, 14-7

QCA 8th Edition, Chapter 13, Sections 13-1, 13-2, 13-3, 13-4, 13-5, 13-6, 13-7

Problems: 14-29, 14-30, 14-35 (9th Edition) 13-25, 13-26, 13-30 in the 8th Edition

Nov. 6 **Redox Titrations**

Learning objectives: Potentiometric titrations

QCA 9th Edition, Chapter 16, Sections 16-1, 16-2, 16-3, 16-4, 16-5, 16-7

QCA 8th Edition, Chapter 15, Sections 15-1, 15-2, 15-3, 15-4, 15-6, 15-7

Problems: 16-2, 16-4, 16-5, 16-6, 16-14, 16-15, 16-16, 16-17, 16-26, 16-32 (9th Edition)

15-2, 15-4, 15-5, 15-6, 15-14, 15-15, 15-16, 15-17, 15-25, 15-30 (8th Edition)

EDTA Titrations

Learning objectives: Metal-chelate complexes, EDTA

QCA 9th Edition, Chapter 12, Section 12-1, 12-2, 12-3, 12-5, 12-6, 12-7

QCA 8th Edition, Chapter 11, Sections 11-1, 11-2, 11-3, 11-5, 11-6, 11-7

Problems: 12-3, 12-6, 12-10, 12-33, 12-35, 12-36 (9th Edition)

11-3, 11-6, 11-10, 11-33, 11-35, 11-36 (8th Edition)

Nov. 13 **Fundamentals of Spectrophotometry**

Learning objectives: Beer’s Law, UV-vis spectrophotometry

QCA 9th Edition, Chapter 18, Sections 18-1, 18-2, 18-3, 18-4 and 18-5

QCA 8th Edition, Chapter 17, Sections 17-1, 17-2, 17-3, 17-4 and 17-5

Problems: 18-12, 18-18, 18-20, 18-22, 18-28 (9th Edition) & 10-74, 10-75 (9th Edition)

17-11, 17-16, 17-18, 17-19, 17-22 (8th Edition) & 10-73, 10-74 (8th Edition)

Nov. 20 MID-TERM-2: Mid-term-2 will contain multiple-choice and short-answer questions. The exam will cover the topics from “Fundamentals of Electrochemistry” until the end of “Fundamentals of Spectrophotometry”.

Nov. 27 **Atomic Spectroscopy**

Learning objectives: Atomization and trace metal analysis

QCA 9th Edition, Chapter 21, Sections 21-1, 21-2, 21-3

QCA 8th Edition, Chapter 20, Sections 20-1, 20-2, 20-3

Problems: 21-1, 21-2, 21-3, 21-4, 21-8, 21-22, 21-24 (9th Edition)

20-1, 20-2, 20-3, 20-4, 20-8, 20-22, 20-24 (8th Edition)

Introduction to Analytical Separations

Learning objectives: Solvent extraction, fundamentals of chromatography

QCA 9th Edition, Chapter 23, Sections 23-1, 23-2, 23-3

QCA 8th Edition, Chapter 22, Sections 22-1, 22-2, 22-3

Problems: 23-8, 23-9, 23-10, 23-12, 23-14, 23-17, 23-20, 23-23 (9th Edition)
22-7, 22-8, 22-9, 22-11, 22-13, 22-16, 22-19, 22-22 (8th Edition)

Evaluation:

Mid-term Exam-1 15%

Mid-term Exam-2 15%

Labs 35%

Final Exam 35%: Your final exam will contain multiple-choice and short-answer questions. The exam will be cumulative with slight emphasis on “Atomic Spectroscopy” and “Introduction to Analytical Separations”.

Total 100%

Course Policies and General Information:

Course Announcements: Announcements, updates to readings, assignment topics, requirements, and evaluation, etc. will be posted to the course site. Students are responsible for checking the course website regularly. **Please, arrange your UTORONTO emails to accept the course announcements.**

Lab Attendance: Attendance at lectures and labs is expected. Attendance is taken in labs and tutorials. If you need to miss a laboratory period for any valid reason, you must contact Dr. Soong by e-mail (ronald.soong@utoronto.ca) before your next scheduled lab period. If the reason for your absence is medical, you must download a UTSC Medical Certificate and have it completed by your doctor (download at:

http://www.utsc.utoronto.ca/~registrar/resources/pdf_general/UTSCmedicalcertificate.pdf

The completed note must contain the following information:

- Verification that you were examined on or before the day of your missed lab
- The nature of your illness
- A statement indicating the physician's professional opinion as to whether you should receive special consideration on medical grounds

Submit your completed medical note to Dr. Soong within one week of your absence. A makeup lab will be rescheduled provided that space and time permits. If a make-up lab is not possible, the marks from the other labs will be re-weighted to make up for the missed lab. Given the importance of the lab component of this course, any labs missed in excess of one will receive a mark of zero, regardless of the reason, and no re-weighting will occur. Labs missed without adequate documentation will also receive a mark of zero.

Ancillary Fees: The Department of Physical and Environmental Sciences at UTSC provides state-of-the-art education in chemistry. Chemistry being an experimental science makes learning in a laboratory setting critical. In order to provide the latest technology to enhance the student learning experience, UTSC will be charging ancillary fees for all chemistry courses that have a laboratory component. Those fees are used to recover the cost of materials and services used during the lab and to maintain and upgrade the equipment used

by students. To view a complete list of those fees, students are encouraged to visit the following link:

<http://www.planningandbudget.utoronto.ca/Assets/Academic+Operations+Digital+Assets/Planning+26+Budget/2012-13+Category+5+Ancillary+Fees.pdf>

Office Hours: Students are welcome to ask questions or resolve course-related problems by contacting the Course Instructor either by dropping in during scheduled office hours or by making an appointment. Students are responsible for work missed as a result of absence; the Course Instructors will not re-teach material covered in the lectures and lab sessions.

e-mail Communication: The Course Instructors may be contacted via the course email addresses to get clarification on course-related issues, or to ask brief questions. The Course Instructor will endeavour to provide responses to emails within 48 h. Urgent issues must be communicated in person or by telephone (with a follow up email message).

Missed Mid-term Test: The exact dates of the mid-term tests are provided in the Course Topics schedule. Students who miss the term test will be assigned a mark of zero for the test, unless they can document a compelling reason for missing it. Students in that position must submit a written request to the Course Instructor with appropriate documentation. If a request is accepted for the mid-term test, the weighting of the mid-term will be included to the final exam. **There will be no make-up mid-term tests.**

Final Examination: The final examination will take place during the UTSC examination period in December following the end of the course. The exact date will be provided when the examination is scheduled.

AccessAbility: Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability/health consideration that may require accommodations, please feel free to approach me and/or the AccessAbility Services Office as soon as possible. The UTSC AccessAbility Services staff (located in S302) are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations (416) 287-7560 or ability@utsc.utoronto.ca. The sooner you let us know your needs the quicker, we can assist you in achieving your learning goals in this course.

Cell Phones: During lectures and labs please put your cell phones in silent mode to avoid disruption of the class. If circumstances warrant use of your cell phone and you must receive an emergency call, please inform the Course Instructor at the beginning of the session in advance and then excuse yourself from the session to respond to the call outside the lecture hall or laboratory.

Academic Calendar: Further information about academic regulations and course withdrawal deadlines can be found in the UTSC Calendar. You are encouraged to read this material.

Centre for Teaching and Learning: If you need assistance with effective writing skills, study skills, exam preparation, note taking, or time management, free workshops and advice are available from the Centre for Teaching and Learning, which can be reached at:

http://www.utoronto.ca/~ctl/Student_Support/index.html

Math & Statistics Learning Centre is now offering students help with any sort of questions they may have related to mathematics and statistics. Our course components involve advanced math skills. If the students are struggling, they are encouraged to drop in at AC312 and use the available general help hours. The schedule can be viewed at the link:

<http://ctl.utoronto.ca/mslc/>

Computer Use: Ethical use of University computers is expected at the University of Toronto Scarborough. Guidelines are set out in the UTSC Calendar. It is expected that the equipment and/or resources accessed in the UTSC Library and the computer labs are to be used for academic research, assignments, and course activities only.

Academic Integrity: Honesty and fairness are considered fundamental to the University's mission, and, as a result, all those who violate those principles are dealt with as if they were damaging the integrity of the University itself. When students are suspected of cheating or a similar academic offence, they are typically surprised at how formally and seriously the matter is dealt with - and how severe the consequences can be if it is determined.

that cheating did occur. The University of Toronto treats cases of cheating and plagiarism very seriously.

Examples of offences for which you will be penalized include (but are not limited to):

- Using any unauthorized aids on an exam or test (e.g., "cheat sheets")
- Representing someone else's work or words as your own - plagiarism (see web document "How not to plagiarize" available online at <http://www.utoronto.ca/writing/plagsep.html>)
- Falsifying documents or grades
- Purchasing an essay
- Submitting someone else's work as your own
- Submitting the same essay or report in more than one course (without permission)
- Looking at someone else's answers during an exam or test
- Impersonating another person at an exam or test or having someone else impersonate you
- Making up sources or facts for an essay or report.

As a student it is your responsibility to ensure the integrity of your work and to understand what constitutes an academic offence. If you have any concerns that you may be crossing the line, please, read from the website

<http://www.utoronto.ca/academicintegrity/resourcesforstudents.html>

and always consult your instructor. Your instructor can explain, for example, the nuances of plagiarism and how to use secondary sources appropriately; he or she will also tell you what kinds of aids - calculators, dictionaries, etc. - are permitted in a test or exam. Ignorance of the rules does not excuse cheating or plagiarism. Students agree that by taking this course all

required papers may be subject to submission for textual similarity review to Turnitin.com for the detection of plagiarism. All submitted papers will be included as source documents in the Turnitin.com reference database solely for the purpose of detecting plagiarism of such papers. The terms that apply to the University's use of the Turnitin.com service are described on the Turnitin.com web site.

This information is taken from the brochure, "Academic Integrity" and website, part of a series of UT publications to help students understand the University's rules and decision making structures. For copies, visit the Office of the Registrar at UTSC. All of the policies and procedures surrounding academic offences are dealt with in one policy: "The Code of Behaviour on Academic Matters". The full text is located in the back of the UTSC Calendar.