Final Course Outline

Analytical Chemistry 1

CHEM 217-51

Gregor Kos

September 13, 2018

1 Course description

Chemistry 217 is an introduction to the theories and concepts of analytical chemistry. Based on your knowledge about Stoichiometry and Acids and Bases, the course material covers basic statistics, acid-base equilibria and associated techniques (e.g., volumetric analysis, gravimetry, introductory spectroscopy) and complex formation. Following a theoretical introduction and background information, a wide range of applications are discussed, including problem sets to be solved mathematically & lab experiments. Examples have direct relevance for work in professional and academic labs (e.g., statistics, buffer preparation, pH calculations, EDTA titrations and chromatography).

2 Course administration

Instructor: Gregor Kos, `gregor.kos@concordia.ca`

Office: Chemistry & Biochemistry, SP-275.29

Office hours: Wed, 15:30–17:00 & Fri, 10:00–11:30; and by appointment.

Prerequisites: CHEM205, 206; PHYS204, 206, 224, 226; MATH 203, 205 or equivalents.

Class time: Wed, 18:00–20:30

Room: CC 116 LOY

Course website: `http://moodle.concordia.ca` (automatic enrolment)

Course text: Daniel C. Harris, Quantitative Chemical Analysis, 9ed, WH Freeman, 2015, ISBN-10: 1-4641-3538-X, ISBN-13: 978-1-4641-3538-5; available in the University Book Store.

3 Clickers

The iClicker/REEF system will be used during lectures for discussion questions and short quizzes. You need to bring your own, registered clicker/device to lectures in order to participate. You also need to register your clicker on Moodle. **Clicker usage will start on 12 Sep 2018**. No accommodation will be made for forgotten devices.

4 Assessment

During the lecture four quizzes and one midterm exam will be given. Together with the cumulative final exam and the lab section (scheduled separately) the the final mark will be calculated:

- Quizzes (4, in-class): 20%
- Clickers: 5%
- Midterm (in–class): 20%
- Final (centrally scheduled): 30%
- Laboratory section: 25%

You need a passing grade (lecture: 50%, lab: 60%) for both, the lecture and lab portion of the course. Material covered for the quizzes will include all material covered since the beginning of term, including the lecture before the quiz.

For the midterm and the final exam, you need to download and print a formula sheet. Bring it to class for practice sessions. No individual notes are allowed on the formula sheet. You may use programmable calculators only after a hard reset in front of the instructor before the exam.

5 Important dates

Date	Event
5 Sep 2018	Classes start
10 Sep 2018	Lab starts
19 Sep 2018	Quiz 1
10 Oct 2018	Quiz 2
14 Oct 2018	Deadline to complete CHEM 101 quiz
24 Oct 2018	Midterm exam
7 Nov 2018	Quiz 3
21 Nov 2018	Quiz 4
TBD	Final exam

6 Attendance

6.1 Lecture

I strongly suggest to attend classes regularly. To be excused from the midterm (no supplemental) or final examination (as per university regulations), you must present a doctor's note or other suitable official excuse. Marks for a missed midterm with an official excuse will be added to the final exam; without excuse a grade of zero will be given for the missed midterm. Missed quizzes will be marked zero (no supplemental).

6.2 Laboratory

Attendance at the laboratory sessions is mandatory. For any missed lab a doctor's note or other official note for the day of the lab is the only acceptable excuse and a make-up lab will be scheduled. You need to complete all experiments in order to receive a passing grade for the lab section. Lab sessions start on Mon, Sep 10, 2018.

7 Course content

Chemistry CHEM 217 is an introduction to the theories and concepts of analytical chemistry. The course will closely follow selected topics from Chapters 0—13 and 27 of the assigned textbook.

7.1 Review Chapters

In preparation for the course, **I strongly suggest to review the following chapters from General Chemistry**. Recommended review chapters were taken from the following resource: Steven S. Zumdahl and Susan A. Zumdahl, Chemistry, 8ed, 2008, Brooks Cole, ISBN-13: 978-0547168173, ISBN-10: 0547168179. If you have access to an alternative textbook, e.g., Kotz-Treichel, please have a look at the equivalent chapters. Do not forget to extensively practice your problem-solving skills.

- Stoichiometry: Chapters 3 & 4
- Chemical Equilibrium: Chapter 13
- Acids & Bases: Chapters 14 & 15
- Redox Chemistry: Chapter 4

7.2 Chapters covered in detail

Chapter 0 – The Analytical Process

Chapter 1 – Chemical Measurements (required reading)

Chapter 2 – Tools of the Trade (required reading)

Chapter 3 – Experimental Error

Chapter 4 – Statistics

Chapter 5 – Quality Assurance and Calibration Methods

Chapter 6 – Chemical Equilibrium (excerpts)

Chapter 7 – Let the Titrations Begin (excerpts)

Chapter 8 – Activity & 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

Chapter 13 – Advanced Topics in Equilibrium

Chapter 23 – Introduction to Analytical Separations (excerpts)

Chapter 25 – High-performance Liquid chromatography (excerpts)

Chapter 21 – Mass Spectrometry (excerpts)

Chapter 27 – Gravimetric Analysis (excerpts)

7.3 Preparatory Reading

The recommended sections are preparatory reading; **these sections do not represent all material covered!** Please refer to your lecture notes, assignments, practice problems, in-class discussions for the complete material covered.

Content	**Preparatory Reading**
Introduction to the course	Course outline
The analytical process	0-1, 0-2
Review: Stoichiometry, solution	1-1 to 1-4
preparation, significant figures,	3-1, 3-2
accuracy, precision	5-2
Errors & error propagation	3-3 to 3-5
Gaussian distribution, population, sample	4-1
Review: mean, std dev, variance	4-1
t-values, Q/Grubbs tests, F-test, t-test	4-2 to 4-6
Quality assurance methods (blanks,	5-1, 5-2
SOP, control charts, validation,	
analytical figures of merit	
Regression & calibration, LOD	4-7, 4-8, 5-3, 5-4

Content	**Preparatory Reading**
Review: Chemical equilibrium,	6-1 to 6-4
solubility product, complexometry	
Mono & polyprotic acids &,	
bases, pH, strong & weak acids	6-5 to 6-7
Systematic treatment of equilibrium 1:	8-4
Charge balance, mass balance	
Weak monoprotic equilibria, buffers	9-2, 9-3, 9-5
Diprotic acid-base eq. & buffers,	10-1, 10-2
principal species (amino acids)	10-4
Fractional composition equations	10-5 & 10-6
Systematic treatment of	8-1 to 8-3, 13-2
equilibrium 2 (full procedure)	8-4 & 8-5
Acid-base titrations 1	7-1, 7-2, 7-6,
	11-2, 11-3
Acid-base titrations 2	11-4 to 11-6
EDTA, K_f, K'_f, $\alpha_{Y^{4-}}$	12-1, 12-2, 12-6
EDTA titrations	12-3, 12-4, 12-7
Gravimetry, combustion analysis	27-1 to 27-4

Content	**Preparatory Reading**
Analytical separations	23-2 to 23-5
Chromatography instrumentation 1	25-2 to 25-4
Chromatography instrumentation 2	25-2 to 25-4
Chromatography applications	Lit.
Working with data	Lit.
Calibration applications	5-3, 5-4
Intercomparison trials	Box 5-4

8 Mandatory Quiz and Seminar

As part of this course, you are required to

1. attend a Chemistry and Biochemistry Departmental Seminar on the academic conduct code and the appropriate use of information sources.

2. pass the online quiz associated with this seminar (the passing grade for the quiz is 100%). **The deadline to take and pass the quiz is Sunday, October 14, 2018 at 11:55 pm**.

Note: This is not the University's quiz you may have been asked to take when you first registered and logged into the myConcordia portal; the one you must take is similar, but graded by the Department of Chemistry and Biochemistry, and you cannot take it until after you have attended the seminar.

The aim of this seminar is to clarify the academic conduct code in terms of what practices will be considered unacceptable with regards to work submitted for grading in Chemistry and Biochemistry courses. You are only exempt from repeating the seminar and the quiz if you have done both in Fall 2013 or more recently [*], otherwise you are required to repeat both this term.

This short seminar (1 hour) will be held at the following times (note that **late-comers will not be admitted**):

Date	**Time**	**Place**
Mon, Sep 24	16:45-17:45	HC-155
Tue, Sep 25	16:45-17:45	CC-116
Tue, Sep 25	20:45-21:45	HB-130
Wed, Sep 26	16:45-17:45	HC-155
Wed, Sep 26	20:45-21:45	SPS-110
Thu, Sep 27	16:45-17:45	CC-115
Fri, Sep 28	16:45-17:45	HB-130

As space for each of the seminars is limited by the room size, please sign up to your preferred time as soon as possible (slots fill up quickly). Sign-up sheets are available two weeks in advance of the seminars outside SP 201.01 (Departmental office). Only sign up in available slots: rooms must not be filled over capacity!

If you do not complete this course requirement, your final grade for the course may be lowered by one full letter grade with an incomplete (INC) notation until such time as this requirement is completed. Please refer to the undergraduate calendar (section 16.3.6) for details on removal of an incomplete notation.

[*] You are exempt, if you can locate your ID in the pdf file on the

departmental website at http://www.concordia.ca/content/dam/artsci/chemistry/docs/Compliance-list.pdf.

9 Plagiarism and other forms of academic dishonesty

The Academic Code of Conduct can be found in section 17.10 of the academic calendar (http://www.concordia.ca/academics/undergraduate/calendar/current/17-10.html). Any form of unauthorized collaboration, cheating, copying or plagiarism found in this course will be reported and the appropriate sanctions applied. The mandatory seminar is a clear and fair opportunity to learn what our faculty regards as academic misconduct. Failure to take part in this learning opportunity and thus ignorance of these regulations is no excuse and will not result in a reduced sanction in any case where academic misconduct is observed.