COURSE OUTLINE
Chem212/2 Analytical Chemistry for Biologists (Section 01) Fall 2019 (3 credits)

1. General Information

Instructor:	Joanne Krupa, Ph.D.
Office	SP 201.14
Office Hours	Wednesday & Friday 12:00 to 13:30
Email address	joanne.krupa@concordia.ca
Course web page	Available on Moodle www.myconcordia.ca
Lecture	Wednesday and Friday 10:15 to 11:30 am Loyola HC-157
Laboratory	Loyola SP-320

2. Required resources for CHEM 212:

Required:

- Daniel C. Harris. Exploring Chemical Analysis, 5th ed., W.H. Freeman and Company. (paper text available in the bookstore)
  Note: W.H. Freeman provides an "online student store" where you can purchase an electronic copy of the required textbook. Please see:
  https://store.macmillanlearning.com/us/?_ga=2.203723280.1430827797.1543246495-1904114192.1494519063

- Analytical Chemistry for Biologists Laboratory Manual (Coursepack).

Suggested:

- Solutions Manual for Exploring Chemical Analysis 5th Edition. W.H. Freeman and Company.

3. Course Description

This course introduces the basic concepts of analytical chemistry to students in the biological sciences. Topics include treatment of analytical data; chemical equilibria and titrations; introduction to spectroscopy; separation science; electrochemistry. Lectures and laboratory.

Prerequisite: CHEM 205, 206; PHYS 204, 206, 224, 226; MATH 205; or equivalents for **all** prerequisite courses.

NOTE: This course may not be taken for credit by students registered in a Chemistry or Biochemistry program

Tentative Lecture Schedule:

Lecture No.	Date (2019)	Chapter –Section: Topic	Comment
1	Sept. 4	0-1 The analytical chemist's Job 0-2 General steps in a chemical analysis	
2	Sept. 6	1-1 SI Units 1-2 Conversion Between Units 1-3 Chemical concentrations 1-4 Preparing solutions 3-1 Significant Figures 3-2 Significant Figures in Arithmetic 3-3 Types of Error 3-4 Propagation of Uncertainty 6-2 Titration Calculations (Stoichiometry calc., volumetric analysis) 7-3 Examples of Gravimetric Calculations (Stoichiometry calc.)	
3	Sept. 11	1-5 Equilibrium constants and how to manipulate them	
4	Sept. 13	8-1 What are Acids and Bases? 8-2 Relation Between $[H^+]$, $[OH^-]$, and pH 8-3 Strengths of Acids and Bases 8-4 Introducing acids and bases 11-1 Polyprotic acids and bases	
5	Sept. 18	6-1 Principles of Volumetric Analysis (endpoint/equivalence point) 8-5 Tools for Dealing with Weak Acids and Bases 8-6 Weak-Acid Equilibrium	
6	Sept. 20	8-7 Weak-Base Equilibrium 9-1 What You Mix Is What You Get 9-2 The Henderson-Hasselbalch Equation 9-3 A Buffer in Action 9-4 Buffer preparation 9-5 Buffer Capacity 9-6 How Acid-Base Indicators Work 10-1 Titration of Strong Base with Strong Acid 10-2 Titration of Weak Acid with Strong Base 10-3 Titration of Weak Base with Strong Acid 10-4 Finding the End Point	
7	Sept. 25	6-1 Principles of Volumetric Analysis (standardization) 6-3 Chemistry in a Fishtank (standardization, blank titration)	
8	Sept. 27	10-5 Practical Notes 10-6 Kjeldahl Nitrogen Analysis 11-1 Amino Acids Are Polyprotic	Quiz No. 1 (portion of the class)

		11-2 Finding the pH in Diprotic Systems 11-3 Which is the Principal Species 11-4 Titrations in Polyprotic Systems	
9	Oct. 2	13-1 Metal-Chelate Complexes 13-2 EDTA 13-3 Metal Ion Indicators 13-4 EDTA Titration Techniques 13-5 The pH-Dependent Metal-EDTA Equilibrium 13-6 EDTA Titration Curves	
10	Oct. 4		
11	Oct. 9	14-1 Redox Chemistry and Electricity Appendix D: Oxidation Numbers and Balancing Redox Equations 14-2 Galvanic Cells 14-3 Standard Potentials 14-4 The Nernst Equation 14-5 E° and the Equilibrium Constant 14-6 Reference electrodes 15-1 The Silver Indicator Electrode (brief-ly for indicator electrodes)	
12	Oct. 11		
13	Oct. 16	15-1 The Silver Indicator Electrode 15-2 Junction Potential 15-3 Membrane electrodes 15-4 pH electrode 15-5 Ion-selective electrodes 16-1 Redox titrations 16-2 Redox indicators	
14	Oct. 18		
15	Oct. 23	18-1 Properties of light 18-2 Absorption of light	
16	Oct. 25		Midterm Exam (entire class)
17	Oct. 30	18-6 Light absorption by a molecule 18-3 Measuring absorbance 18-4 Beer's law in chemical analysis 18-6 Fluorescence & phosphorescence	
18	Nov. 1		
19	Nov. 6	18-7 Fluorescence measurements 19-5 Immunoassays 18-3 Measuring absorbance 20-1 Lamps as sources of light	
20	Nov. 8		
21	Nov. 13	20-2 Monochromators 20-3 Detectors 21-1 What is mass spectrometry?	
22	Nov. 15		Quiz No. 2 (portion of the class)
23	Nov. 20	21-1 Information in an MS	

24	Nov. 22	EI source ESI source Resolving power of mass analyzers Quadrupole mass analyzer **Reconstructed** total ion chromatogram **Selected** ion chromatogram **Extracted** ion chromatogram MS/MS and selected reaction monitoring (SRM) Orbitrap mass analyzer	
25	Nov. 27	22-1 What is chromatography? 22-1 Efficiency of separation 22-3 High-performance liquid chromatography (HPLC)	
26	Nov. 29		
			Cumulative Final Exam: Date to be arranged by the Concordia University Examinations Office

NO recording (audio/video etc) of lectures is allowed.

General Information:

I will be using PowerPoint presentations during my lectures and I will make those slides available to you on-line. They DO NOT fully replace the textbook but rather serve as a summary of many of the main topics. The relationship between the lectures and the textbook are not always one-to-one. I will be providing additional material to what is in the textbook (e.g. mass spectroscopy) and you are responsible for this information. You should review the notes and textbook before AND after each class.

A good understanding of analytical chemistry is not possible without time and practice solving problems. You are strongly encouraged to solve problems on your own. There are many problems/questions in the textbook and you are encouraged to work through as many as your schedule will allow. Many answers are available in the back of the text and expanded solutions are found in the *Solutions Manual for Exploring Chemical Analysis 5th Edition*. For best results, seriously try the problems/questions without referring to the answers. It is very easy to convince yourself that you understand a topic if you look up the answer prematurely without testing your own abilities first. Ensure you check your reasoning as well.

This course is *challenging* since it covers quite a bit of material. It can thus become overwhelming quite quickly if you do not keep up. The material cannot be learned the night before a

midterm, quiz, or final exam! There are many good internet resources available and several textbooks available in the library. *Furthermore, please feel free to come and see me if you have any problems regarding the course material.*

Laboratory information:
Lab coats and safety glasses are compulsory during the practical laboratories as well as closed toe shoes. The laboratory coordinator is still to be determined. The Chemistry 212 laboratories are located at L-SP 320. Laboratories start the week of September 9, 2019**.**

Since space in the labs is limited. All students *must* attend their lab section.

Laboratory Exemption: Students who are repeating the course, having passed the lab component within the past two (2) years (with a grade of 60% or more), may be eligible for a lab exemption. A student who is denied a lab exemption must repeat the laboratory component of the course. When a student receives a lab exemption for a lab taken at Concordia, the previous lab mark will be used again in determining the new grade. Applications for the exemption (forms available in SP201.01) must be completed by the end of the first week of term (September 6th) (*i.e.* prior to the start of the laboratory); late applications will not be accepted. Signed and completed forms are to be returned to Hilary Scuffell, (SP 275.01). Students MUST register for the appropriate lab exemption section; students registered in any other lab section will be required to complete the lab portion of the course (NO EXCEPTIONS).

Course withdrawal: Students who wish to withdraw from the course must notify the Office of the Registrar. November 4th, 2019 is the last day for academic withdrawal (DISC) from Fall-term courses. *Students who withdraw from this course must also check-out from their lab section.* Students who do not properly withdraw before the specified deadlines will receive failing grades.

4. Grading

The final grade of the course is based on the marks obtained in the (i) examinations, (ii) quizzes and (iii) laboratory. The composition of the final grade is as follows:

Midterm exam:	25%
Final exam:	40%
Quizzes (2):	10% (5% each)
Laboratory:	25%
Total:	**100%**

If you miss a quiz, a mark of 0 will be given (no make-up quiz will be given). Material for the quizzes is cumulative, that is it may contain material from the beginning of term. In addition, material covered in the lecture prior to the quiz date may be tested.

There will be **one** midterm exam – (date: Oct. 25, 2019). The midterm will contain material from the beginning of term to the lecture prior to the midterm date. The final exam date will be arranged by the Concordia University Examinations Office. The final exam will be **cumulative** and thus cover all the material in the course. There may be multiple versions of the exams. If you miss an exam, you will receive a mark of 0% for it, unless you have a valid excuse. If you miss a midterm exam due to an illness, you must provide a written note (signed by a medical doctor on the

appropriate letterhead paper) during the next possible class. There are no make-up midterm exam. If you miss the midterm exam, with a valid excuse, your final exam will be worth 65% of your final grade. If you cannot provide a valid excuse, a grade of 0% will be assigned to the midterm. It is also your responsibility to take note of the time, place and date of all exams.
Note: Only non-programmable calculators will be allowed during quizzes, the midterm exam and the final exam.
If you write both the final and midterm exam and the grade you received on the final exam is higher than that of the midterm, the final exam will be worth 50% of your final grade, and the midterm 15%.

Laboratory performance is graded on the quality of the experimental work, the laboratory reports as well as on pre-lab. Each of the labs will require you to complete a lab report. All lab reports contribute to your overall lab grade. If you cannot attend a lab due to a valid documented excuse, you must contact the lab coordinator to schedule a make-up lab. However, even if you miss more than one lab due to a valid excuse, the department will only schedule you one make-up lab. In addition, you cannot redo a lab to better your grade for a particular lab. Please consult the lab manual for additional information.

To pass:

Labs: You must obtain an overall mark of **60%** in the lab section to pass the course. A grade of less than 15/25 will result in an "R" grade which means you must repeat the entire course.

Theory: You must obtain an overall mark of 50% in the theory to pass the course. A grade of less than 37.5/75 will result in an "F" grade which means you must repeat the theoretical component of the course.

Grading scale:

Mark	**Letter Grade**
If lab mark is <60%	R
If theory mark is <50%	F
0 - 49.9	F
50.0 - 52.9	D-
53.0 - 56.9	D
57.0 – 59.9	D+
60.0 – 62.9	C-
63.0 – 66.9	C
67.0 – 69.9	C+
70.0 – 72.9	B-
73.0 – 76.9	B

77.0 – 79.9	B+
80.0 – 84.9	A-
85.0 - 89.9	A
90.0 and greater	A+

In the event of extraordinary circumstances beyond the University's control, the content and/or evaluation scheme in this course may be subject to change.

5. Rights and Responsibilities

Plagiarism:
The most common offense under the Academic Code of Conduct is plagiarism which the Code defines as, *"the presentation of the work of another person as one's own or without proper acknowledgement."*

Source: The Academic Integrity Website: http://www.concordia.ca/students/academic-integrity/plagiarism.html

Mandatory Quiz & Seminar:
As part of this course, you are ***required*** to i) attend a Chemistry and Biochemistry Departmental Seminar on the academic conduct code and the appropriate use of information sources and ii) pass the online quiz associated with this seminar (the passing grade for the quiz is 100%). (**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 do not have access to 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 2014 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 (Fall 2019)	Time	Room
Monday, Sept. 16	16:45-17:45	CC 111
Tuesday, Sept. 17	16:45-17:45	CC 308
Tuesday, Sept. 17	20:45-21:45	HB 130
Wednesday, Sept. 18	16:45-17:45	CC 308
Wednesday, Sept. 18	20:45-21:45	HB 130
Thursday, Sept. 19	16:45-17:45	HC 155
Friday, Sept. 20	16:45-17:45	HC 157

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!

The quiz must be taken before Sunday, October 6, 2019 at 11:55pm.

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 16.3.5) for details on removal of an incomplete notation.

* You are exempt if you can locate your ID in the pdf file located on the Departmental web site (http://www.concordia.ca/content/dam/artsci/chemistry/docs/Compliance-list.pdf).

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.

6. Improving Your Academic Experience

The University offers many services that can help students:

Concordia Counseling and Psychological services:
http://www.concordia.ca/students/counselling.html

The Concordia Library Citation and Style Guides:
https://library.concordia.ca/help/citing/index.php

Advocacy and Support Services - http://www.concordia.ca/offices/advocacy.html/

New Student Program - http://www.concordia.ca/students/new.html

Access Centre for Students with Disabilities: *http://www.concordia.ca/offices/acsd.html/*

Financial Aid & Awards - https://www.concordia.ca/offices/faao.html

Health Services - https://www.concordia.ca/students/health.html