

**The University of Western Ontario
Department of Chemistry**

**Physical Chemistry for Life Sciences, Chem 2214b
January-April 2011**

COURSE OUTLINE

Notice from the Registrar: Unless you have either the prerequisites for this course or written special permission from your Dean to enroll in it, you will be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites, which are the former [Chemistry 1050](#) or 1020 or 023; 1.0 course from [Calculus 1000A/B](#) or [Calculus 1100A/B](#) plus 0.5 course from [Calculus 1201A/B](#), [1301A/B](#), [1501A/B](#) or [Linear Algebra 1600A/B](#); or [Applied Mathematics 1413](#); or [Mathematics 1225A/B](#) plus [1229A/B](#); or [Mathematics 1225A/B](#) plus [Calculus 1201A/B](#); or the former Mathematics 030. Antirequisites are the former [Chemistry 2274A](#), 254, 224a or 234b.

Course website: <http://webct.uwo.ca>

Lectures

- MWF 14:30 – 15:30, P&AB-34 (Physics and Astronomy Building).
- Instructor: Dr. Styliani Conostas, Chemistry Building, Room 071.
Phone number: 519-661-2111 x 86338
e-mail : sconstas@uwo.ca

Labs

- Friday 9:30 am-12:30 pm at Chemistry Building (ChB) 110.
- You will do labs every other week (see schedule for details).

Lab Instructor: Dr. Doug Hairsine (scidwh@uwo.ca)

Lab Assistants: Matthew Ward (mward46@uwo.ca)

Lijia Liu (lliu249@uwo.ca)

Office hours : Wednesdays 12:30pm-14:00 in Chemistry Building, Room 071 or another date by appointment.

Required materials

- "CHEM2214b Laboratory Manual", which contains laboratory experiments. The manual will be posted in the webct site of the course.
- Handouts that will be distributed in the class and become available in the course website.
- *Required text:* "Physical Chemistry for the Life Sciences" by P. Atkins and J. de Paula (third printing, published in Canada by W. H. Freeman and Company). The textbook is available at the

UWO book store. The solutions manual is optional. Wait and see whether you need the optional manual.

- Lab coat, safety glasses, proper footwear (shoes must cover the entire foot), socks, and ankle-length pants must be worn in the lab.

Course evaluation

- The course grade, out of 100, will be calculated as listed below.
 - 3 problem sets (15 marks).
 - Two-hour midterm exam (30 marks) on Wed. February 16, 5:30 pm-7:30 pm (the date will be discussed in the class on January 3rd for the availability of the students. If the students are not available because of a conflict with another course the date might change.)
 - Three-hour final exam (35 marks), date set by the Registrar. This exam is cumulative, but it will emphasize the material not covered on the midterm exam.
 - 4 labs (20 marks).
- To pass the course, you must obtain a minimum of 50% both in the labs and in the final. One should write the final exam. Obtaining a good average grade in the assignments, labs and midterm is not sufficient to pass the course.
- You should be familiar with the Scholastic Offense Policy in the Academic Calendar. Scholastic offenses are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offense, at the following Web site: http://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_undergrad.pdf.
- It is the policy of the Department of Chemistry that when a student takes a test or an examination, one should have deemed oneself fit to do so. Claims of distress or medical issues after the fact will not be considered as a basis of a grade appeal.
- Plagiarism is a serious Scholastic Offense. Students should write their essays and assignments individually. Copying of assignments will involve penalties in the grades. In essays, whenever a student takes an idea or a passage from another source, appropriate reference should be given.

Accessibility

Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.

Absences, Code of Conduct

- Failure to complete or write an experiment, the midterm, or the final, will result in a mark of zero for the missed item, and potential failure in the course, unless a valid medical or compassionate reason has been approved and an exemption has been granted. The Policy of Accommodation for Medical Illness is found in the web site: <https://studentservices.uwo.ca/secure/index.cfm> and

for further policy information please visit
http://www.uwo.ca/univsec/handbook/appeals/accommodation_medical.pdf

(notice the underscore in accomodation_medical.pdf in the above web address).

- If you miss a laboratory experiment for a valid reason, present documentation to an academic counselor in your Dean's office. If your documentation is approved proper accommodation will be made by allowing for you to do the lab another week or reweighing your lab mark.
- If you miss the midterm exam for a valid reason, contact an academic counselor in your Dean's office. Proper accommodation will be made.
- If you miss the final exam, contact your Dean's office to obtain an SPC form. Students who are ill, for all exams and tests yet choose to write the final exam, must accept the mark that they receive.
- Students are reminded of the university's *Code of Conduct* found on the university website. To maintain a high standard of learning environment in our classrooms and laboratories those who are disruptive, rude, or show unacceptable behavior, either to the instructor, the TA, or the other students, will be asked to leave.

Course Description:

The course provides an understanding of the basic concepts of the physical chemistry and illustrates their applications. The laws of thermodynamics will be discussed and applied to chemically and biologically interesting systems. An important objective is to introduce and work with free energies and chemical potentials in relation to chemical and physical equilibria. Introduction and aspects of spectroscopy will be studied. Some important aspects of the molecular motion - the processes of diffusion, solvation, and sedimentation will be reviewed.

Lecture Topics:

1. Introduction (Chapter Fundamentals of Atkins).
2. The properties of gases: Ideal gas law and van der Waals equation of state (Chapter Fundamentals of Atkins).
3. The first law of thermodynamics: work, heat, expression of the first law, enthalpy, internal energy (Biochemical Thermodynamics: Chapter 1 of Atkins' textbook).
4. Thermochemistry (Biochemical Thermodynamics, Chapter 1 of Atkins' textbook).
5. Entropy, the second law of thermodynamics, and Gibbs free energy (Biochemical Thermodynamics, Chapter 2 of Atkins' textbook).
6. Phase equilibria: Temperature and pressure dependence of Gibbs Free energy, the phase diagram (Biochemical Thermodynamics, Chapter 3 of Atkins' textbook)
7. The thermodynamic description of mixtures: ideal solutions, Rault's law, Henry's law, colligative properties (Biochemical Thermodynamics, Chapter 3 of Atkins' textbook).
8. Chemical equilibrium: relation between the equilibrium constant and the change in the Gibbs free energy, electrochemistry (Biochemical Thermodynamics, Chapter 4 and Chapter 5 of Atkins' textbook) .
9. Diffusion and diffusion coefficient. Fick's first and second laws. Solvation and sedimentation. (Chapter 8 of Atkins' textbook).
10. Spectroscopy: Beers' Law. UV-Visible spectroscopy and fluorescence. Infrared spectroscopy. Proton nuclear magnetic Resonance, Circular Dichroism, Optical rotation and Optical Rotatory Dispersion. Mass spectrometry. (Chapter 13 of Atkins' textbook).

Additional readings: *Physical Chemistry, Principles and Applications in Biological Sciences*, Fourth Edition, Ignacio Tinoco, Jr., Kenneth Sauer, James C. Wang, Joseph D. Puglisi, Prentice-Hall Inc., 2002. *Introduction to Spectroscopy, a Guide for Students of Organic Chemistry*. Second Edition, Donald L.Pavia, Gary M.Lapman, George S. Kriz, Saunders College Publishing, 1996.

Tentative lab schedule

| dates | Group A | Group B |
|----------|--------------------------|--------------------------|
| Feb. 4 | Vapour pressure exp. | |
| Feb. 11 | | Vapour pressure exp. |
| Feb 18 | Electromotive force exp. | |
| March 4 | | Electromotive force exp. |
| March 11 | Diffusion exp. | |
| March 18 | | Diffusion exp. |
| March 25 | Viscosity exp. | |
| April 1 | | Viscosity exp. |