Physical Chemistry (Lab)

ROOSEVELT UNIVERSITY

Department of Biological, Chemical and Physical Sciences

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Course meetings. Lab (CHEM321/421–24B)
W 6:50 PM – 9:50 PM (SCH552)
Discussion (Lab/Lecture)
M 7:50 PM – 08:40 PM (SCH562)

Course dates. Start: August 28
Final Exam: December 13 (Regular class hour)

Credit hours. 2

Office hours[b]***.*** Schaumburg (SCH600R)
M 5:00 – 6:00 PM
W 5:30 – 6:00 PM

Required textbook. Garland, Nibler, and Shoemaker (2009). Experiments in physical chemistry[c]. McGraw-Hill, New York, 8^{th} edition. ISBN: 978-0072828429

A pocket calculator, a lab coat laboratory and safety goggles (not regular glasses) are required for all laboratory sessions. A bound laboratory notebook is also required.

Prerequisites. CHEM 212 with a min grade of C-. MATH 232 with a min grade of C-.

[a] Expect a reply within two days, excluding Saturdays and Sundays.
[b] If your schedule conflicts with these office hours, please make an appointment with the instructor.
[c] This book is referred to "GNS" in this syllabus.

Last updated: October 9, 2017

CHEM 321/421–24B

Course Syllabus
Fall 2017

Overview

This course is designed to provide laboratory experience to complement the physical chemistry lecture course, CHEM321/421-24A which presents the principles of physical chemistry that govern equilibria and reaction rates in chemical systems. Laboratory experiments will be related to properties of thermodynamic properties of substances, thermochemistry, chemical and phase equilibria, reaction kinetics.

The university's three overall learning goals for undergraduate students are:

- effective communication,
- knowledge of disciplined-focused content, and
- awareness of social justice and engagement in civic life.

Learning outcomes

At the end of this course you should be able:

- to determine experimentally extent of chemical reactions, their rates, and amount of energy released, as well as basic thermodynamic characteristics of substances,
- to carry out quantitative treatment, analysis and presentation of experimental data, and
- to work on laboratory (spectral and electrochemical) instruments commonly used in industrial and academic setting.

This class will consist of laboratory experiments, report preparations and discussion.

Blackboard LMS

Lab reports will be collected through both paper-based (dropped off in class and electronic-based (MS Word file) submitted trhough Internet Blackboard/TurnitIn). *Electronic versions are required in order to get a grade on lab reports.*

There are eight experiments in this lab

Lab #	Experiment #	Title
Lab 1	GNS 3A	Heat Capacity Ratios for Gases
Lab 2	GNS 6	Heats of Combustion (Calorimetry)
Lab 3	GNS 9	Partial Molar Volume
Lab 4	GNS 13	Vapor Pressure of a Pure Liquid
Lab 5	Handout	Acid Dissociation Constant (pKa) of Methyl Red
Lab 6	Handout	Chemical Equilibrium in Solution
Lab 7	Handout	Cyclic Voltametry
Lab 8	Handout	Kinetics of Reaction

The laboratories are performed by groups of two or three students according to the schedule below. In addition to 8 laboratory works, there will be a lab quiz at the end of the course.

Lab Periods (*)

Each group will have four lab periods (designated below with *) for which lab experiments are not scheduled. During these periods, students should be present in the lab to turn in lab reports and to discuss them with the instructor, to prepare the next experiment and/or to complete the unfinished experiment (if equipment is available without hindering work of the group which carries out the same experiment according to the schedule).

Schedule of the laboratory experiments

Date	Activity
08/30	Check in / Introduction
09/06	Lab 1
09/13	Lab 2
09/20	*[1]
09/27	Lab 3
10/04	Lab 4
10/11	*
10/18	Lab 5
10/25	Lab 6
11/01	*
11/08	Lab 7
11/15	Lab 8
11/22	Thanksgiving Holiday
11/29	*
12/06	Lab quiz / Check out

[1] Complete the unfinished lab, prepare to the next lab, turn in and discuss reports.

Grading

Each laboratory work and a final quiz will be graded on the scale from 0 to 100 points. Final grade will be determined as an average of the 8 grades - best 7 works (i.e. a lowest- grade lab work will be excluded) and quiz.

Final grade distribution by total points

Letter grades will be assigned according to the following grade intervals.

- A ..... 92.0 and more
- A- ..... 89.0 – 91.9

- B+ ..... 86.0 – 88.9
- B ..... 82.0 – 85.9
- B- ..... 79.0 – 81.9

- C+ ..... 76.0 – 78.9
- C ..... 72.0 – 75.9
- C- ..... 69.0 – 71.9

- D+ ..... 66.0 - 68.9
- D ..... 62.0 - 65.9
- D- ..... 59.0 - 61.9

- F ..... below 59.0

Grade for Each Lab

Grade for each lab will be based on preparation, performing and results of work (50%) and lab report (50%).

Preparation, performing and results of work (50%)

Success of experiments will be determined primarily by your preparation to the work. Before each work, you should know how specifically you will do experiment, what instrumentations you will use and how to use it, what chemicals and their solutions you will need. If solution of certain concentration will be used, you should know how to prepare it (you will have to know exactly how much of each substance to take). Before work, the instructor will check preparation of each student and use results in the grading of the lab. After finishing work, you should show results to the instructor. Don't forget to clean working place and glassware.

Post-Laboratory Meeting/Discussion: To help ensure you have a thorough understanding of your experiment, you and your partner must attend to the discussion session scheduled every Mondays. In addition, every two weeks, your group will have lab periods, in which you should meet the instructor and be ready for resolving any problems you might have had in the laboratory. In rare cases, major problems may require you to return to the laboratory to repeat the experiment (in part or in its entirety) without a due date extension.

The post-laboratory meeting/Discussion

Post-Laboratory Meeting	Maximum Points
Attendance	8 or 4
Preparation	4 or 2
Participation	4 or 2
Response to Impromptu Questions	4 or 2

It is expected that nearly all of the data analysis will be completed and a first draft of the report is written before arriving at these meetings. In egregious cases where it is clear students have not prepared, the meeting will be adjourned and a score of 0 will be awarded for this section of the assignment.

Lab report (50%)

Lab reports are due two weeks after the completion of the corresponding experiments. Points will be deducted for the late lab report. No materials will be accepted after the final exam (Lab Quiz).

The report should include the following (points will be deducted for the missing parts):

1. A **cover sheet** containing
   (a) Your name, Lab number and Title of experiment.
   (b) Date on which an experiment was performed and date submitted.
   (c) Name(s) of partner(s).
2. **Abstract**: Brief (about 1/3 of a page) summary of your work and results. The report abstract is a concise summary of your experiment. It should contain brief information about the particular system you studied (e.g., the chemicals used), the physical and chemical principles you explored, the general technique you used, the final results (with uncertainties), whether those data agree with the literature and to what confidence interval, and the overarching scientific interpretation of the major results. The abstract should not read as a full procedure or a litany of results. It should not contain references. It is separate from the introduction section of the report (see below). If a person were to read nothing but your abstract, he/she should at least have a basic understanding of what you did. Every scientific journal article contains an abstract. It is often the most difficult section to write due to word limits imposed by the publisher. All of your abstracts must be less than 150 words in length; abstracts longer than the 150-word limit will receive a 1-point reduction.

The Abstract is worth 5 points

Abstract	Points Awarded
Excellent	5
Above Average	4
Average	3
Below Average	2
Poor	1
Absent	0

3. **Introduction**: description of the purpose of an experiment and a theoretical background (1-2 pages). The report introduction is comprised of concise sentences that give the reader the scientific background necessary to understand the experiment at hand and a sense of the importance and relevance of the eventual results of the experiment. The reader should be able to look at the introduction and have a good understanding of what you propose to do and discuss. You are encouraged to include references to the literature (beyond textbooks and any literature cited in the laboratory manual) that are relevant to your experiment. The Introduction is graded on both scientific content and writing style.

The Introduction–Scientific Content is worth 5 points

Intro—Scientific Content	Points Awarded
Excellent	5
Above Average	4
Average	3
Below Average	2
Poor	1
Absent	0

The Introduction–Writing Style is worth 5 points

Intro—Writing Style	Points Awarded
Excellent	5
Above Average	4
Average	3
Below Average	2
Poor	1
Absent	0

4. **Experimental Procedure**: Here, outline the procedure(s) given in the laboratory manual or prepare a flow chart. Also, include a table of physical and chemical properties of all chemicals used during the experiment which are relevant for the work (usually,

it is molecular weights, melting or boiling points, etc). It is usually sufficient to simply reference the source of the experiment from which you obtained the procedure. While the bulk of the procedure may be referenced, you will invariably have to do other tasks outside of the procedure that should be included in this section as well. For example, you may have to calibrate a thermometer even through the official procedure does not say to do so. Sometimes, the instrument you use may differ from the one described in the official procedure; therefore, you should clearly identify all of the major instrumentation used in your experiment. (Side note: Any and all procedural variations should be included on the right-hand side of your laboratory notebook pages.) If there were absolutely no variations from the official procedure, state so clearly; otherwise, you may be penalized.

The Experimental Procedure is worth 5 points

Experimental	Points Awarded
Referenced, No Omissions	5
Referenced, Minor Omissions	4
Referenced, Major Omissions	3
Referenced, No Variations Noted	2
Improper Reference	1
Absent	0

5. **Results of the Experiment**: Briefly describe what you did (you don't need to repeat a detailed description of the experiment if you presented it in the previous section) and what original results you got (i.e. pressures, temperatures, pH). Results could be presented in a tabular form, but you have to provide an explanation how you obtained them, not just present a table. Each numerical value should be written with the appropriate number of the significant figures. Spectra could be attached at the end of the report.

The Results of the Experiment is worth 5 points

Presentation of Final Results	Points Awarded
Present, Proper Sig Figs and Units	5
Present, Improper Sig Figs or Units	4
Present, Improper Sig Figs and Units	3
Present, No Sig Figs or Units	2
Attempted	1
Absent	0

6. **Discussion of the Experiment**: Describe the treatment of the original data you obtained. Draw graphs and figures. Present results which you obtained from the treatment. Analyze errors and accuracy of your results. Compare results with theoretical and/or literature data. Discussion grades are based on your performance in the following four subjective categories: discussion of error, comparison to accepted or theoretical values, scientific insight/journal reading, and writing style

The Discussion of Error is worth 5 points

Discussion of Error	Points Awarded
Excellent Understanding	5
Above Average Understanding	4
Average Understanding	3
Below Average Understanding	2
Poor Understanding	1
Absent	0

The Comparison to Accepted Values is worth 5 points

Comparison to Accepted Values	Points Awarded
Present, Appropriate	5
Present, Minor Problems	4
Present, Major Problems	3
Present, Not appropriate	2
Attempted	1
Absent	0

The Scientific Insight/Journal Reading is worth 5 points

Scientific Insight/Journal Reading	Points Awarded
Excellent	5
Above Average	4
Average	3
Below Average	2
Poor	1
Absent	0

The Writing Style is worth 5 points

Writing Style	Points Awarded
Clear and Concise	5
Above Average	4
Average	3
Below Average	2
Muddled	1
Absent	0

7. **Conclusion of the Experiment**: Give a brief statement how successful was your work, what you obtained and what you learned performing the experiment. The conclusion is an analogue to the introduction. Here, however, you want to summarize the findings of your experiment in a reasonably short section: recap the final values, their errors, how they compare to accepted values, and the main takeaway of the experiment based on your scientific interpre-

tation. You should also suggest future experiments, which should logically follow from the results of the current experiment. Never, under any circumstances, report that you "had a fun time" doing the experiment, that "everything went well" in the laboratory, or that "the experiment was a success". Your reader only wants to know the final value of your work and a statement of its significance.

The Conclusion is worth 5 points

Conclusion–Writing Style	Points Awarded
Excellent	5
Above Average	4
Average	3
Below Average	2
Poor	1
Absent	0

8. **References**: Materials taken directly from other sources and incorporated into your report must be properly referenced. Reference notation and the bibliography must follow the format used in the Journal of Physical Chemistry. If you are not familiar with scientific referencing, consult the laboratory textbook or ask a member of the teaching staff.

The References is worth 5 points

References	Points Awarded
Complete, No Omissions	5
Complete, Minor Formatting Issues	4
Complete, Major Formatting Issues	3
Bibliography Only	2
Incomplete	1
Absent	0

9. **Supplementary Information**: Copy of your notes taken during the lab experiment (see section "Laboratory Notebook" below), spectra, copies of your calculations (if they are not included in the report) and similar supporting data. The Supplemental Information section of your report houses Appendices A, B, and C. The grade for this section reflects the extent to which each appendix is used to support the work presented in your report. One point is awarded for the presence of appendices in your submitted paper.
10. **Return of Graded Materials**: Every effort will be made to return your graded laboratory report within two weeks of the submission date. A grade sheet will be attached to your report, which indicates the points earned for each of the components listed above. In addition, there will be comments throughout the report. The comments are meant to be helpful for writing future reports, so be sure to look at all of the comments throughout the graded report.

Laboratory Notebook

You must record all data in a bound laboratory notebook. Such notebooks can be obtained from the bookstore or any other office supply store. Make sure that you write your name on your notebook along with any other pertinent contact information so that your notebook can be returned to you if it is lost. Also, reserve the first few pages of the notebook for a table of contents.

All data recorded in the laboratory must be recorded on the right-hand pages of the notebook in black or blue ink only—pencils and other ink colors are not allowed, unless for scratch work. You must also make a carbon copy of each page either by placing a sheet of carbon paper directly under the notebook page, followed by an official Chemistry 305 data sheet that is available in the laboratory, or by using carbonless laboratory notebooks. It is your responsibility to make sure that your carbon copies are legible.

The right-hand pages must contain any and all pieces of information that are crucial to obtaining final results for your experiment. Such information includes, but is not limited to:

- The title of the experiment
- The name of your laboratory partner, if applicable
- The date and time of your experiment
- A detailed list of procedural changes
- A detailed list of equipment and its condition
- Clearly written data with the proper number of significant figures and units (preferably in a table)
- Clearly written intermediate calculations with the proper number of significant figures and units (when necessary)

At the end of each laboratory, you and your partner must each submit all carbon copies of your right-hand notebook pages. This information will be used to independently verify your experimental results. The burden is on you to make sure you have all of the data necessary to write a successful laboratory report. If any information is missing, your experimental results will not be able to be checked and you risk receiving substantial penalties on your laboratory report. Carbon copies will not be accepted after you leave the laboratory for the day.

The left-hand pages of your notebook can be used for scratch calculations or other notes that do not have a direct bearing on the outcome of your experiment. If you wish to communicate information about your experiment that is relevant to the processing of its data, it must always be on a right-hand notebook page.

In certain experiments, you may be using a computer to acquire data electronically. Such data will be stored on the computer's local hard drive. In this case, you should bring a clean USB drive with you to the laboratory to make electronic copies of the original data sets. A copy of all electronic data sets should also be submitted to the appropriate Blackboard folder.

Please be aware that your laboratory notebook is subject to inspection to verify and authenticate your experimental observations.

Additional Items of Note

- Attendance of each class is critical for a successful completion of this course. Make-up labs will be allowed only in cases of documented emergency or illness at instructor discretion. They will be carried only during regular lab hours if it will not hinder work of other students.
- Cell phones and other electronic communication devices must be turned off during all class periods. Leave the lab in a proper order and as clean or cleaner as you found it.
- Changes to this syllabus may be made when deemed appropriate.

Policies

Academic Dishonesty

The university's policies on issues such as plagiarism, recycling, cheating and other forms of academic dishonesty can be found in the undergraduate catalog at http://catalog.roosevelt.edu/undergraduate/policies/academic-integrity-policy and the graduate catalog at http://catalog.roosevelt.edu/graduate/policies/academic-integrity Additional guidelines for avoiding plagiarism are available here: https://www.roosevelt.edu/current-students/academics/academic-integrity.

Disability

Roosevelt University complies fully with the Americans with Disabilities Act. Details about ADA and Roosevelt's policies and practices are found in the following link: https://www.roosevelt.edu/student-experience/disability-services. If you have a condition or disability that requires reasonable accommodation, please alert your instructor or the Academic Success Center as soon as possible, certainly before any assignment or classroom activity that requires accommodation. The Academic Success Center is located in AUD1050 (inside the Library) in Chicago, and the phone number is 312-341-3818. In Schaumburg, the office is in room 125, and the phone number is 847-619-7978. Email Adam Wouk or Danielle Smith at dsmith51@roosevelt.edu.

Withdrawal/Incomplete Grades Rules

I (incomplete)

A grade of Incomplete may be given only with the consent of the instructor and appropriate notification to the registrar. An Incomplete grade specifies to the student and to the registrar that only a small portion of the total semester's work needs to be completed (e.g., the student must take a final examination, complete a paper, or similar requirements), that the student is academically able to complete the work, and that the student has presented a satisfactory reason to the instructor for not completing the work within the deadline of the regular semester. Students must complete the course requirements prior to the end of the following term. A student may also be given an extension of an Incomplete due to extraordinary circumstances, for example if the instructor will not be available during the following semester to ensure that the work is completed. Under such circumstances, the instructor will submit an extension date in writing to the registrar. The Incomplete grade will be removed when the instructor submits a letter grade evaluating academic progress (A, B, C, D, P, F) within the above deadline. If no grade is submitted and no extension granted, the registrar will automatically convert the Incomplete grade on the deadline date to the default grade (B, C, D, or F) submitted by the faculty member at the time of granting the original Incomplete grade.

Withdrawal

The final date for an official withdrawal from this class (meaning a "W" would appear on your transcript) is November 02. In order to withdraw after that date, you must petition for a late withdraw with the registrar. Petitions are granted only for non-academic reasons after the deadline. You should consult your academic advisor if you are considering withdrawing from a course. If you receive financial aid, also check with your financial aid counselor to assure that aid isn't affected by withdrawing from a class. The complete withdrawal policy is here: https://www.roosevelt.edu/current-students/academics/register-classes.

Religious holidays

Roosevelt University policy requires written notification to the instructor within the first two weeks of the term. Any work you miss because of a religious holiday can be made up. You can see the full policy here: https://www.roosevelt.edu/policies/religious-holidays.

Student Code of Conduct

Students enrolled in the university are expected to conduct themselves in a manner compatible with the university's function as an educational institution. https://www.roosevelt.edu/current-students/get-help/complaint/student-misconduct.

Title IX

Roosevelt University cares greatly about the health and well-being of our students, staff, faculty, and guests to our campuses. Federal law, specifically Title IX, and the University Sexual Misconduct Policy require that all employees are mandated reporters of incidents involving sexual or gender-based violence or harassment.

Disclosures made to faculty or teaching assistants (TAs) about sexual or gender-based harassment, sexual assault, dating violence, domestic violence, and/or stalking on or off campus must be forwarded to the Title IX Coordinator. The above listed staff are Responsible Employees and therefore are mandated to report. The Title IX office will contact any student who discloses an incident regarding student rights, including the option to request an investigation, interim safety measures, and/or academic accommodations. In certain circumstances, the Title IX Coordinator may need to proceed with an investigation, even if none is requested, if there are safety risks to the student or campus community. Participation in the process is voluntary.

If you want a confidential place to disclose sexual assault, sexual harassment or intimate partner violence, there are two confidential advisors on campus who are not mandated reporters. They are: Audrey Guy (312)244-0577, LaDonna Long (312)244-0426. Both are available via phone all hours. The Counseling Center (430 S. Michigan Avenue Room 470 Phone: 312-341-3548) staff are also NOT mandatory reporters and therefore not required to report a disclosure to the Title IX Office.