CHM 335
Physical Chemistry Laboratory
Fall 2024 Course Syllabus

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Required texts:

Physical Chemistry Laboratory by Garland, Nibler and Shoemaker; McGraw-Hill, 2018; ISBN-13:9781307253931. **Note**: Exclusive URI Package only available from the URI Bookstore!

Co-/Prerequisites:

CHM 431

Location:

Beaupre 280 (lab), with occasional meetings in Beaupre 300 as announced

Overview:

This course aims to introduce experimental methods in the physical chemistry lab that complement the study of the principles of thermodynamics, kinetics, and spectroscopy. It will also provide comprehensive training in error analysis and propagation as well as an introduction to contemporary data analysis methods with a focus on nonlinear regression.

Lab safety:

You must always wear safety glasses with side guards and a lab coat while in the lab; accordingly, you must have them on before you enter. These items must be either purchased from or approved by the URI Chemistry Stockroom. You must also always wear closed-toed shoes. If you are ever in the lab without eye protection, a lab coat, or closed-toed shoes, you will have 5 points deducted from your next lab report. If you do not have the appropriate personal protective equipment with you, you will not be allowed into the lab to begin your experiment until you have retrieved it, and you will not be given additional time to complete your experiment. Repeated offenses will result in failure in the course. Be sure to bring your eye protection and lab coat to the second meeting of the course so you can perform the first experiment of the semester.

All students must complete the Department Safety and Environmental Compliance Form. All students must also have their Medical Information Form with them during every lab period.

Course outline and requirements:

This course consists of nine experiments divided into two groups of four plus a final experiment at the end of the semester. The first four experiments are designed to gradually teach you how to extract and analyze data and write a complete lab report. Each of the first set of four experiments is performed by every set of partners in a section during the same lab period; each of the second set is performed by one set of partners in a given lab period, and the equipment is rotated among the groups from week to week.

All experiments will be performed with one or two lab partners. **Although you will collect data with your partners, you are responsible for every part of your own lab reports. Identical or nearly identical lab reports from two or more students are treated as cases of plagiarism.**

In the first experiment, you will determine the phase diagram of a binary molecular mixture.

In the second experiment, you will measure the viscosity of polyvinyl alcohol in water. The purpose of this experiment is to instruct you in the principles of experimental error. You will repeat your measurements many times to observe the statistical distribution of error, and your lab report on will emphasize the analysis of these errors.

In the third experiment, you will not perform any measurements yourself. Instead, you will be given a dataset measured by previous CHM 335 students with viscosity measurements of polyvinyl alcohol solutions following chemical degradation. In lab, we will introduce data analysis methods in MATLAB, and you will be required to use MATLAB for this and all remaining lab reports.

The fourth experiment is a study of the diffusion of ionic species in water. You will analyze graphical data using MATLAB and confirm that concentration gradients migrate with a particular functional dependence on the time.

The second set of four experiments includes 1) the vapor pressure of a pure liquid; 2) the freezing point depression of weak electrolytes; 3) the heat of combustion of organic compounds; and 4) the heat capacity ratio of gases. Complete lab reports are required for each of these experiments.

In the ninth and final experiment of the semester, you will study the surface tension of butanol solutions.

In the final week of classes, you will be given an in-person assessment in the form of a MATLAB data analysis practical.

Data collection:

Whenever possible, data generated in the lab should be entered directly into a lab notebook. You must bring a lab notebook **that generates duplicate pages** with you to each lab session. These can be purchased in the bookstore or online, but be sure you are purchasing a notebook that generated duplicate pages!

In some instances, the data you generate cannot be entered into the notebook. Your TA will inform you when the notebooks are not required. The copy of your data signed by your TA should be included in the data portions of your laboratory reports.

Grades:

Each lab report is worth 100 points. These reports are due one week after the completion of a given experiment at the beginning of the lab session. The reports must be submitted both as hard copies and electronically, and the electronic reports must be uploaded before coming to class. If classes do not meet exactly one week after an experiment, the report is due on the next date the University is officially open. Hard copies may be turned in later if you have no reason to come to campus that day, but electronic reports must be submitted by the starting time of your lab section on that day. Late reports will be accepted for grading but are assessed a penalty of **5 points** for each day that they are late. **THIS INCLUDES WEEKENDS AND UNIVERSITY HOLIDAYS AND CLOSURES!** The required components for each lab report will be included in a presentation given by your TA before the corresponding experiment and will also be made available online. The in-class MATLAB practical is also worth 100 points.

Your grades are determined on an absolute scale. The scale is

A	930 to 1000 points
A-	900 to 929
B+	870 to 899
B	830 to 869
B-	800 to 829
C+	770 to 799
C	730 to 769
C-	700 to 729
D+	670 to 699
D	600 to 669
F	< 600

Lab procedure:

Before beginning any of the experiments in this course, you must prepare an outline of the experimental procedure at home and bring it to class with you. Your TA will then review your procedure and sign and date the outline before you begin the experiment. If your TA finds your outline insufficient, you will be required to revise it before you can begin your experiment. The signed outline must be also attached to your lab report; a lab report cannot be graded without the signed outline attached.

At the completion of an experiment, you must present your data to your TA, who will then sign and date the notebook pages and collect the duplicate copies. These will then be included with your lab report when it is graded. A lab report cannot be graded without the duplicate notebook pages, so you MUST remember to give these to your TA before you leave the lab session; to ensure the fidelity of your data, you CANNOT submit your notebook pages after leaving the lab session.

Plagiarism:

One of our goals in this course is to reinforce the importance of scientific integrity. In recent years, there have been numerous examples of established scientists generating falsified data or copying material from another source. Acts of plagiarism damage science, destroy scientific careers, and negatively impact society. Consequently, we want to make clear to you what plagiarism is and penalize acts of plagiarism in a manner that emphasizes its seriousness.

Your lab reports contain information about the purpose, theory and results of your experiments. Each of you will write a lab report associated *only* with your name. By implication, you are the sole author of that report, and no section of your report can be identical (or nearly identical) to that of another person without attribution. Reports or sections of reports identical to any other source – whether that be another student, a section of a book, or online content – is treated as plagiarism. This includes all written work *and* all calculations!

For the first instance of plagiarism, the corresponding section(s) will receive a grade of 0. For the second instance of plagiarism, the entire report will receive a 0, and the incident will be reported to the Dean of the appropriate college, the Dean of the College of Arts & Sciences, and the Chair of the Department of Chemistry.

In CHM 335, there is one important exception to this policy. Whenever you generate data with a lab partner, the original data included in your reports *must* be identical to that of your partner; if your data do not agree, that could be considered an example of malicious data manipulation.

As an example, we consider the fourth experiment of the semester, in which you determine the diffusive behavior of ionic salts in water. The data from this experiment are several curves drawn on sheets of paper generated as a function of time. At the end of the experiment, you and your partner will have several sheets of paper with the same curves. You will then photocopy or scan the sheets and take either the original sheet or the photocopy. These sheets must then be included in your lab report, and the data are clearly identical for you and your partner.

To analyze this data, you must *independently* generate quantitative data from the graphs using digital methods to be discussed later this semester. It is impossible for these values to be identical between partners even though the curves are identical. Thus, if you and your lab partner have

identical *quantitative* data in your lab reports for this experiment, this would be an example of plagiarism.

Plagiarism can also easily occur if you do not analyze your data by yourself. Students often work together, and the plagiarism policy is not designed to discourage collaborative learning. However, your calculations must ultimately be your own and will be done in your own unique fashion. The sections of your reports containing the calculations must not be identical or nearly identical to those of anyone else. In general, it is not possible for any two people analyzing the same data to obtain exactly the same set of calculations in the same order with the same final results. To avoid even the appearance of plagiarism, if you decide to study with another student, you must perform your calculations by yourself or with the help of one of the instructors. Nearly identical calculation sections are examples of plagiarism.

If you use artificial intelligence (AI) to write any section of your lab reports, we caution that you are still fully responsible for the content. If the AI program has taken content from another source without attribution and you have used that content in your report, such content would be viewed as plagiarism, and the repercussions would be the same. Additionally, any content that an AI program produces that is incorrect will be viewed as your content and marked as incorrect. We have tried using some AI programs to write sections of lab reports for CHM 335 experiments, and we have found the results to contain significant errors. If you decide to use AI software, we suggest you use the software to write a first draft with the expectation that the draft will require significant correction and/or revision.

The CHM 335 Brightspace page:

All written materials, including the syllabus and supplemental materials for labs, will be posted to the CHM 335 Brightspace page. You must also submit all lab reports through the Brightspace "Assignments" tab.

Viral illness precautions:

The University is committed to delivering its educational mission while protecting the health and safety of our community. Students who are experiencing symptoms of viral illness should NOT go to class/work. The CDC says people with these types of illnesses should stay home until they have been fever-free without medication for at least 24 hours and their symptoms have been improving. If you are unable to attend class, please notify us prior to the start of class by emailing both Prof. Hayes (dugan@uri.edu) and Prof. Thomas (dathomas@uri.edu).

Excused absences:

Absences due to serious illness or traumatic loss, religious observances, military service, or participation in a university sanctioned event are considered excused absences. Students are responsible for work missed during an excused absence but will not be penalized by grading or assignment/exam make-up policies. Students should notify faculty in advance of absences due to religious observance or university-sanction events, and as soon as possible for other absences. See University Manual sections 8.51.11-8.51.16 for details.

Mental health and wellness:

We understand that college comes with challenges and stress associated with your courses, job/family responsibilities and personal life. URI offers students a range of services to support your mental health and wellbeing, including the URI Counseling Center, TELUS Health Student Support app, the Wellness Resource Center, and Well-being Coaching.

Land acknowledgement:

The University of Rhode Island land acknowledgment is a statement written by members of the University community in close partnership with members of the Narragansett Tribe. The statement recognizes and pays tribute to the people who lived on and stewarded the land on which the University now resides. The statement seeks to show gratitude and respect to Indigenous people and cultures and build community with the Narragansett Nation and other Native American tribes.

University of Rhode Island Land Acknowledgment

The University of Rhode Island occupies the traditional stomping ground of the Narragansett Nation and the Niantic People. We honor and respect the enduring and continuing relationship between the Indigenous people and this land by teaching and learning more about their history and present-day communities, and by becoming stewards of the land we, too, inhabit.

Anti-bias:

We respect the rights and dignity of each individual and group. We reject prejudice and intolerance, and we work to understand differences. We believe that equity and inclusion are critical components for campus community members to thrive. If you are a target or a witness of a bias incident, you are encouraged to submit a report to the URI Bias Resource Team at www.uri.edu/brt. There you will also find people and resources to help.

Disability, Access, and Inclusion services for students:

Your access in this course is important. Please send me your Disability, Access, and Inclusion (DAI) accommodation letter early in the semester so that we have adequate time to discuss and arrange your approved academic accommodations. If you have not yet established services through DAI, please contact them to engage in a confidential conversation about the process for requesting reasonable accommodations in the classroom. DAI can be reached by calling 401-874-2098, visiting web.uri.edu/disability, or emailing dai@uri.edu.

Schedule:

Week 1: Introduction and orientation (meet in Beaupre 300)
Tuesday - Sept. 10
Thursday - Sept. 5
Friday - Sept. 6

Week 2: Phase diagram
Tuesday - Sept. 17
Thursday - Sept. 12
Friday - Sept. 13

Week 3: Viscosity of polyvinyl alcohol, pt. 1 (meet in Beaupre 300 before lab)
Tuesday - Sept. 24
Thursday - Sept. 19
Friday - Sept. 20

Week 4: Viscosity of polyvinyl alcohol, pt. 2 (meet in Beaupre 300)
Tuesday - Oct. 1
Thursday - Sept. 26
Friday - Sept. 27

Week 5: Diffusion of salt solutions
Tuesday - Oct. 8
Thursday - Oct. 3
Friday - Oct. 4

Week 6: Make-up
Tuesday - Oct. 22 (note: no class on Oct. 15)
Thursday - Oct. 10
Friday - Oct. 11

Week 7: First round of rotations
Group A - Heat capacity ratio of gases
Group B - Vapor pressure
Group C - Freezing point depression
Group D - Heat of combustion
Tuesday - Oct. 29
Thursday - Oct. 17
Friday - Oct. 18

Week 8: Second round of rotations
Group D - Heat capacity ratio of gases
Group A - Vapor pressure
Group B - Freezing point depression
Group C - Heat of combustion
Tuesday - November 6 (note: Tuesday classes meet on Wednesday)
Thursday - Oct. 24
Friday - Oct. 25

Week 9: Third round of rotations
Group C - Heat capacity ratio of gases
Group D - Vapor pressure
Group A - Freezing point depression
Group B - Heat of combustion
Tuesday - Nov. 12
Thursday - Oct. 31
Friday - Nov. 1

Week 10: Fourth round of rotations
Group B - Heat capacity ratio of gases
Group C - Vapor pressure
Group D - Freezing point depression
Group A - Heat of combustion
Tuesday - Nov. 19
Thursday - Nov. 7
Friday - Nov. 8

Week 11: Surface tension
Tuesday - Nov. 26
Thursday - Nov. 14
Friday - Nov. 15

Week 12: Make-up
Tuesday - Dec. 3
Thursday - Nov. 21
Friday - Nov. 22

Week 13: MATLAB data analysis practical (meet in Beaupre 300)
Tuesday - Dec. 10
Thursday - Dec. 5
Friday - Dec. 6