

## Advanced Measurement Techniques I (CH 452; 4 credit hours) – Fall 2022

### Instructors:

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**Office hours:** by appointment via Zoom, please email us to arrange a suitable time.

### Purpose

The main purpose of CH 452 is to:

**Develop skills in proper *scientific methodology* in particular pertaining to *quantitative measurement*.**

Students learning outcomes:

- Familiarizing the student to a number of techniques and instruments, used in Analytical and Physical Chemistry.
- Activating and using the knowledge of the principles of these disciplines the student already has.
- Acquiring skills in safe and effective laboratory practice, including the use of a lab notebook.
- Acquiring skills in processing measured data correctly, by graphical, statistical and other means. This includes issues of precision, accuracy, stability and absence of outliers.
- Acquiring skills in properly designing experiments.
- Acquiring skills in reporting scientific observations and conclusions, both in written and oral form.
- Acquiring skills in scientific collaboration with other scientists
- Acquiring and improving skills in more self-active, less teacher dependent learning

Students will perform a series of experiments *individually* and produce *written reports* of their experimental results and the quantities that can be calculated from them. Proper organization of the information is a major focus.

### Teaching Assistants:

LAB Section	Teaching Assistant (contact info)
001A MW 1:30-4:15PM	Adara Bacon ( <a href="mailto:akbacon@ncsu.edu">akbacon@ncsu.edu</a> )
001B MW 1:30-4:15PM	Dylan Denison ( <a href="mailto:jddeniso@ncsu.edu">jddeniso@ncsu.edu</a> )

### Course Material:

There is no required textbook to purchase for this course. Nevertheless, the following two textbooks are valuable reference tools and supplement to lectures and lab. (1) D.P. Shoemaker, C.W. Garland and J.W. Nibler, *Experiments in Physical Chemistry*, 6<sup>th</sup> Ed. (1996) and (2) D.A. Skoog, F. J. Holler and T.A. Nieman, *Principles of Instrumental Analysis*. These two books have been placed on reserve in the library. However, physical textbooks are not currently circulated and the NCSU library is providing scanned PDF chapters to students through the program Textbooks and Chapters Online (TACO). Navigate to this page: <https://cdla.lib.ncsu.edu/about> to learn more and to request/access scans.

Course material and any assigned readings will be provided electronically and will cover information relevant to the lab topics.

The spreadsheet of choice for this lab is Microsoft Excel. There is a version present in the lab for in-lab analysis, needed for some of the experiments. A basic proficiency in Excel is assumed present for every student, but considerable additional use, particularly of the Statistics options of the spreadsheet, will be taught in the course of the lab. A book "Statistics using Microsoft Excel" is present for reference in the lab.

A laptop is strongly encouraged for this lab but not required. If you use your laptop, the Data Analysis pack needs to be loaded in Excel.

### Course Description:

Modern analytical and physical chemistry laboratory techniques. Emphasis on statistical methods, chemical thermodynamics, chromatography, atomic and molecular spectroscopy, report writing, scientific methodology, and laboratory safety.

The laboratory can be thought of as having three phases: I, II and III. The phases reflect some difference in materials, but mainly an increase responsibility for the student in giving shape to the experimentations as time moves on. Phase I consists of the basic computer laboratories and 3 analytical experiments. Phase II consists of experiments in physical chemistry. Students will be expected to use their knowledge statistics, propagation of error and accuracy in their work. Phase III is an independent (or team) research project. The final project phase involves informal *oral reporting* on a weekly basis culminating in a formal presentation and a final written report.

The course will include a weekly, 75 min lecture session on Fridays (11:45AM-1:00 PM) in Dab 623 and two laboratory session (check your lab section days/times) that will be held in Dabney 608. **In the early part of the semester, some lab periods will be used for computer lab tutorials/assignments. A tentative lab schedule is included at the end of this document**

### Attendance

Attendance is required at both the lectures and laboratories as listed in the class schedule. Missing a lab results in a grade of 0 for the lab report for the missed lab period. If the missed lab is due to a university valid excuse (see <https://policies.ncsu.edu/regulation/reg-02-20-03-attendance-regulations/>), you must provide written documentation to your TA as soon as possible to arrange for a make-up preferably during another lab section during the same week, if available. Missing more than two lab sessions will lead to a grade of incomplete (IN) for the course if the absence is due to a university valid excuse (see <https://policies.ncsu.edu/regulation/reg-02-20-03-attendance-regulations/>), otherwise, a grade of Fail (F) will be assigned.

### Final Grades

The following percentages will be used

Practice lab report (1): **7%** (only experimental and results sections)

Homework Assignments: **7%**

Lab reports (4): **40%** (10% each)

FTIR of HCL Demo quiz (1): **2 %**

Computational lab assignment/quizzes: **16%** (4% each)

Project and presentation: **28 %** - Written lab report (20%) and Oral presentation (8%)

### Letter Grades

The standard NCSU letter grading scale is used for this course:

$97 \leq A+ \leq 100$	$93 \leq A < 97$	$90 \leq A- < 93$
$87 \leq B+ < 90$	$83 \leq B < 87$	$80 \leq B- < 83$
$77 \leq C+ < 80$	$73 \leq C < 77$	$70 \leq C- < 73$
$67 \leq D+ < 70$	$63 \leq D < 67$	$60 \leq D- < 63$
$0 \leq F < 60$		

### Labs

**Lab Protocols:** All lab protocols must be read BEFORE coming to lab and must be brought to the laboratory.

**Lab Notebooks:** A bound notebook (with carbon copy) should be brought to each lab period. Reserve the first page of your notebook for the table of content (which will be updated as the semester progresses). Prior to coming to lab, you are strongly encouraged to write the purpose of the lab in your notebook. Each lab must be dated, the page numbered, and must include a purpose, a reference to the protocol, and annotation of any deviations to the protocol given by the instructor or taken by you. All recorded data should also be included in your notebook (tabulated form) as well as calculations and preliminary graphs. A proper record of the filenames and contents of electronic files should also be entered if appropriate. You must complete your notebook entries before leaving the lab. Include your partner's name for each experiment and use a ballpoint pen or other permanent marker that provides a *permanent* record. Errors are crossed out with a single stroke, never erased. Provide carbon copy at the end of each lab.

**Oral Presentation:** At the end of the project phase (cycle III), students will present their results in the form of an oral presentation and will also submit a written report. In the project phase, lecture time will be used by the students to give a brief *oral progress report* on their work in preparation for the final presentation. During the presentations week, students are required to be audience on days when they are not presenting. Grading rubric for the oral presentation will be provided before the start of the project phase.

**Lab Reports:** See the provided rubric for the written lab reports. Written reports are due on Saturday evening (11pm) of the following week. **There is a 2% penalty per day for late lab reports. Lab reports that are more than two weeks late will not be accepted. A student may be refused entry into the project phase if they have not turned in previous work.**

This penalty system is designed to prevent an impossible pile up of report writing work at the end of the semester, when exams and tests will inevitably take up your time and energy. The same grading rubric used to grade the first six lab reports will be used to grade the final lab report.

## Tentative list of Lab Topics

### Experiments:

- Practice Lab
- pKa determination by HPLC
- Fluorescence quenching
- Adiabatic compression of a gas
- UV-vis Spectrophotometry of d- and f-elements

### Demonstration:

- FTIR Spectroscopy of HCl

### Computer Labs:

- Least squares (GR)
- Non-linear regression (GR)
- Matrices (SF)
- FFT (SF)

**Note:** Computer labs assignments should be completed and submitted during the scheduled lab period.

## Student Project

The project will be an experiment that the student plans and executes with a partner of his/her choosing. The student will present the results and relevant background information during a Power Point presentation. Specific details of the independent project will be discussed a few weeks into the semester.

## Academic Integrity

Students are required to comply with the university policy on academic integrity found in the Code of Student Conduct found at <http://policies.ncsu.edu/policy/pol-11-35-01>

### **University Disability Policy:**

Reasonable accommodations will be made for students with verifiable disabilities. Students are required to first register with Disability Services Office (<http://www.ncsu.edu/dso/>) and to then contact the instructor to discuss options for accommodation. For more information on NC State's policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation at <https://policies.ncsu.edu/regulation/reg-02-20-01/>

### **University Anti-discrimination policy:**

NC State University provides equality of opportunity in education and employment for all students and employees. NC State's policies and regulations covering discrimination, harassment, and retaliation may be accessed at <https://policies.ncsu.edu/policy/pol-04-25-05/>

### **Class Evaluations**

Online class evaluations will be available for you to complete during the last two weeks of class. Students will receive an email message directing them to a website where they can login using their Unity ID and complete evaluations. All evaluations are confidential; instructors will never know how any one student responded to any question, and students will never know the ratings for any particular instructors.

**The following information related to COVID-19 was created by the Associate Deans of Academic Affairs, DELTA, the Registrar's office, and NC State Libraries.**

Due to the COVID-19 pandemic, public health measures continue to be implemented across campus. Students should stay current with these practices and expectations through the [Protect the Pack](https://www.ncsu.edu/coronavirus/) website (<https://www.ncsu.edu/coronavirus/>). The sections below provide expectations and conduct related to COVID-19 issues.

### **Health and Participation in Class**

We are most concerned about your health and the health of your classmates and instructors/TAs.

- If you test positive for COVID-19, or are told by a healthcare provider that you are presumed positive for the virus, you should not attend any face-to-face (F2F) classes or face-to-face component of a hybrid class. Work with your instructor on any adjustments necessary; also follow other university guidelines, including self-reporting ([Coronavirus Self Reporting](#)): Self-reporting is not only to help provide support to you, but also to assist in contact tracing for containing the spread of the virus.
- If you feel unwell, even if you have not been knowingly exposed to COVID-19, please do not come to a F2F class or activity.
- If you are in quarantine, have been notified that you may have been exposed to COVID-19, or have a personal or family situation related to COVID-19 that prevents you from attending this course in person (or synchronously), please connect with your instructor to make alternative plans, as necessary.

## Health and Well-Being Resources

These are difficult times, and academic and personal stress are natural results. Everyone is encouraged to [take care of themselves](#) and their peers. If you need additional support, there are many resources on campus to help you:

- Counseling Center ([NCSU Counseling Center](#))
- Student Health Services ([Health Services | Student](#))
- If the personal behavior of a classmate concerns or worries you, either for the classmate's well-being or yours, we encourage you to report this behavior to the NC State CARES team: ([Share a Concern](#)).
- If you or someone you know are experiencing food, housing or financial insecurity, please see the Pack Essentials Program ([Pack Essentials](#)).

## Community Standards related to COVID-19

We are all responsible for protecting ourselves and our community. Please see the [community standards](#) and Rule 04.21.01 regarding Personal Safety Requirements Related to COVID-19 [RUL 04.21.01 – Personal Safety Requirements Related to COVID-19 – Policies, Regulations & Rules](#)

## Course Expectations Related to COVID-19:

- **Face Coverings:** All members of the NC State academic community are expected to follow all university policies and guidelines, including the [Personal Safety Rule](#) and [community standards](#), for the use of face coverings.
- **Course Attendance:** NC State attendance policies can be found at: [REG 02.20.03 – Attendance Regulations – Policies, Regulations & Rules](#). Please refer to the course's attendance, absence, and deadline policies for additional details. If you are quarantined or otherwise need to miss class because you have been advised that you may have been exposed to COVID-19, you should not be penalized regarding attendance or class participation. However, you will be expected to develop a plan to keep up with your coursework during any such absences. If you become ill with COVID-19, you should follow the steps outlined in the health and participation section above.
- **Technology Requirements:** This course may require particular technologies to complete coursework. Be sure to review the syllabus for these expectations, and see the [syllabus technical requirements](#) for your course. If you need access to additional technological support, please contact the Libraries' Technology Lending Service: ([Technology Lending](#)).

## Course Delivery Changes Related to COVID-19

Please be aware that the situation regarding COVID-19 is frequently changing, and the delivery mode of this course could change accordingly, including from in-person to remote. Regardless of the delivery method, we will strive to provide a high-quality learning experience.

## NO LONGER AVAILABLE - Grading/Scheduling Changing Options Related to COVID-19

Two policies, enhanced S/U Grading Option and Late Drop, put in place at the beginning of the COVID-19 pandemic have been discontinued.

In some cases, an option may be to request an "incomplete" in the course. If you are experiencing difficult or extenuating circumstances, you should discuss possible options with your instructor and your academic advisor.

## Need Help?

If you find yourself in a place where you need help, academically or otherwise, please review these [Step-by-Step Help Topics](#). **Please do not hesitate to reach out to your TA or course instructor to assist you with anything!**

## Other Important Resources

- Keep Learning: [Keep Learning](#)
- Protect the Pack FAQs: [Frequently Asked Questions | Protect the Pack](#)
- NC State Protect the Pack Resources for Students: [Resources for Students | Protect the Pack](#)
- Academic Success Center (tutoring, drop in advising, career and wellness advising): [Academic Success Center](#).
- NC State Keep Learning, tips for students opting to take courses remotely: [Keep Learning Tips for Remote Learning](#)
- Introduction to Zoom for students: <https://youtu.be/5LbPzzPbYEw>
- Learning with Moodle, a student's guide to using Moodle: <https://moodle-projects.wolfware.ncsu.edu/course/view.php?id=226>
- NC State Libraries [Technology Lending Program](#)

## Tentative Schedule

Week	Lab day 1	Lab Day 2	Lecture (DABNEY 623)	Report Due
1 (Aug 22-26)	<b>8/22 (001A&amp;001B)</b> <b>Zoom</b>  Lab logistics / Data Recording & Reporting  homework#1  pre-assessment.	<b>8/24 (001A&amp;B)</b> <b>Zoom</b>  Writing (continued) and Rounding & Propagation of Error  homework#2	<b>8/26 (GR)</b>  Statistics, Distributions, Least square analysis & RLS Practice lab report requirements. homework#3 (manual RLS 1D)	-
2 (Aug29-Sep2)  <b>Sep 2 – census date</b>	<b>8/29 (001A)</b> Lab safety and check in & Practice lab – lab safety homework#4  <b>(001B)</b> Computer Lab: Calibration Lines	<b>8/31 (001A&amp;B) (001A)</b> Computer Lab: Calibration Lines  <b>(001B)</b> Lab safety and check in & Practice lab – lab safety homework#4	<b>9/2 (GR)</b> Overview of homework submissions. Analytical experiment 1	
3 (Sep 5-9)  <b>Sep 5 Labor Day</b>	<b>9/5(001A&amp;B)</b>  <b>NO LAB (Labor Day)</b>	<b>9/7 (001A)– Dab608</b> Analytical Experiment 1 – day1  <b>(001B) – Dab613</b> Computer Lab: Non-linear least squares fitting	<b>9/9 (GR)</b> Overview of HPLC day 1 results/lab report material and intro to non-linear regression.	Practice Lab Assignment <b>DUE</b> (Experimental and Results sections)
4 (Sep 12-16)	<b>9/12</b>  <b>(001A)– Dab613</b> Computer Lab: Non-linear least squares fitting  <b>(001B) – Dab608</b> Analytical Experiment 1 – day1	<b>9/14</b>  <b>(001A)– Dab608</b> Analytical Experiment 1 – day2  <b>(001B) – Dab613</b> Writing lab report	<b>9/16 (GR)</b> Overview of analytical lab 2 (Fluorescence) and Feedback on Practice Lab submission	
5 (Sep 19-23)	<b>9/19 (001A&amp;B)</b> <b>(001A) – Dab613</b> Writing lab report  <b>(001B) – Dab608</b> Analytical Experiment 1 – day2	<b>9/21 (001A)– Dab608</b> Analytical Experiment 2 – day1  <b>(001B) – Dab613 (SF)</b> Computer Lab: Matrices and Complex numbers	<b>9/23 (GR)</b> Overview of Fluorescence lab reports and lab report requirements. Take questions for HPLC lab report due next day	<b>Lab Report 1 DUE 9/25 at 11PM</b>
6 (Sep26-30)	<b>9/26 (001A)– Dab613 (SF)</b>	<b>9/28 (001A)– Dab608</b>	<b>9/30 (SF)</b>	

	Computer Lab: Matrices and Complex numbers  <b>(001B)</b> – Dab608 Analytical Experiment 2 – day1	Analytical Experiment 2 – day2  <b>(001B)</b> – Dab613 Writing lab report	Physical Experiments (UV vis/adiabatic expansion) & Briefing on FFT computer lab	
7 (Oct 3-7)	<b>10/3 (001A&amp;B) (SF)</b> <b>(001A)</b> – Dab613 Writing lab report  <b>(001B)</b> – Dab608 Analytical Experiment 2 – day2	<b>10/5</b> <b>(001A)</b> – Dab608 Physical Experiment 1  <b>(001B)</b> – Dab608 FTIR Demo	<b>10/7 (SF)</b> Discussion of results of lab experiment and lab report requirements  <b>FTIR Demo QUIZ</b>	<b>Lab Report 2</b> <b>DUE 10/9 at</b> <b>11PM</b>
8 (Oct 10-14) <b>Oct 10-11 Fall</b> <b>break</b>	<b>10/10(001A&amp;B)</b> <b>No Lab (Fall break)</b>	<b>10/12</b>  <b>(001A)</b> – Dab608 FTIR Demo  <b>(001B)</b> – Dab608 Physical Experiment 1	<b>10/14 (SF)</b> Discussion of results of lab experiment and lab report requirements	
9 (Oct 17-21)  <b>October 19 –</b> <b>drop date</b>	<b>10/17 (SF)</b> <b>(001A)</b> – Dab608 Physical Experiment 2  <b>(001B)</b> – Dab613 Computer Lab: FFT	<b>10/19 (SF)</b> <b>(001A)</b> – Dab613 Computer Lab: FFT  <b>(001B)</b> – Dab608 Physical Experiment 2	<b>10/21 (SF&amp; GR)</b> Project proposals /discussions student progress reporting (project goals, literature and planned lab work for next lab) <b>(NOTE: Students must</b> <b>have 3 reports</b> <b>submitted to enter</b> <b>project phase)</b>	<b>Lab Report 3</b> <b>DUE 10/23 at</b> <b>11PM</b>
10 (Oct 24-28)	<b>10/24</b> Project	<b>10/26</b> Project	<b>10/28</b> student progress reporting	
11 (October 31- Nov4)	<b>10/31</b> Project	<b>11/2</b> Project	<b>11/4</b> student progress reporting	<b>Lab Report 4</b> <b>DUE 11/6 at</b> <b>11PM</b>
12(Nov7-11)	<b>11/7</b> Project	<b>11/9</b> project	<b>11/11</b> student progress reporting	
13 (Nov14-18)	<b>11/14</b> Project	<b>11/16</b> Project	<b>11/18</b> student progress reporting	
14 (Nov 21-25) <b>Nov23-25</b> <b>Thanksgiving</b>	<b>11/21</b> Project	<b>11/23</b> <b>No Lab (Happy</b> <b>Thanksgiving!)</b>	<b>11/25</b> <b>No Class (Happy</b> <b>Thanksgiving!)</b>	
14 (Nov28- Dec2)	<b>11/28</b> Project	<b>11/30</b> Practice presentations	<b>12/2</b> Practice presentations	
December 5 – LAST day of classes	12/5 Final Presentations			Final Project Report DUE <b>Monday</b> <b>December 12</b>



