

CHE 357
Physical Chemistry Laboratory II
Spring 2021

Instructor

Professor Tim Korter

Email: tmkorter@syr.edu

All course materials will be available via: <http://blackboard.syr.edu> (CHE.357.M001)

Prof. Korter is a physical chemist working with various laser spectroscopies and quantum mechanical simulations to study the intermolecular forces that exist within complex materials and govern their macroscopic properties.

Teaching Assistants

There are two Teaching Assistants (TAs) for the CHE357 course. They are graduate students in the Department of Chemistry performing physical chemical research as they work toward their doctoral degrees. The primary responsibility of the TAs is running the hands-on laboratory component of the course. Each TA is in charge of specific lab experiments where they will help you set up your experiments, guide you in interpreting results, and grade laboratory activities.

- Alec Beaton (aabeaton@syr.edu)
- Margaret Davis (mdavis23@syr.edu)

Class Times and Locations

Lab Lecture (M001): Monday 2:15pm-3:35pm in Carnegie Library Room 219

Lab "Practical" (two sections, but attend only the one you are registered for) - Life Science Building Room 301

- Wednesday 2:15pm-5:15pm (M004)
- Thursday 2:00pm-4:45pm (M003)

Office Hours

Office hours for Prof. Korter and the teaching assistants are held via Zoom by appointment. Appointments are arranged via e-mail.

*****If you have any questions about the lab lectures, the experiments, the exams, or anything else, it is the responsibility of the student to contact Prof. Korter in a *timely* manner for help.*****

Course Description

Physical Chemistry is the part of chemistry that is specifically focused on the quantitative relationships between measurements of static and dynamic physical and chemical properties of matter and energy and theories of the microscopic nature of matter and its interactions involving the electromagnetic force. What is actually known about such fundamental and far-reaching things has resulted from careful experimentation and comparison with theory. During this semester, we will concentrate on spectroscopic measurements of various kinds and the kinds of microscopic information that is accessible via quantitative theoretical interpretation of those results. This exposure will not be exhaustive, but should serve as a basis for the student to utilize as they progress into new areas of chemistry on their own.

Reading Materials

There is no required textbook for this course and all necessary materials to perform the laboratory work will be provided. HOWEVER, students will be expected to *independently* use the library, Internet, and other sources to support their learning especially for writing complete and detailed laboratory reports. For example, the textbook used for the concurrent CHE356 lecture course will be a valuable resource of fundamental information. **When used in preparing lab reports, information sources of all types must be clearly cited with complete bibliographic information.**

Overall Laboratory Schedule

*****All students must arrive to class on time.***** If a student arrives late, there may be insufficient time remaining to complete the necessary work and that student may not be permitted to carry out the experiment at all. Students may not leave the laboratory until they are finished completely unless they obtain permission from the TA in charge.

*****In case of illness (or required quarantine/isolation), you should inform Prof. Korter by email as soon as possible and prior to class time is preferred so that accommodations can be made.*****

*****There will be no make-up laboratories except in the case of approved absences. All make-up laboratories must be approved and scheduled by Prof. Korter.*****

There will be six laboratory exercises (labelled Lab A – Lab F) this semester. All laboratories are held in person on the Syracuse University campus in Life Science Building (LSB) Room 301. To maintain pandemic safety protocols, each student will be working individually.

*****Each student has a unique laboratory schedule for this semester since all laboratory work is done individually.*****

Students will be assigned numbers 1 through 14 and then alternate through the different experiments each week as indicated in the schedule below. The student number designations only affect lab scheduling, nothing else. Individual in-lab instrumentation work will be limited to 50-minute periods as detailed in the lab schedules below. This permits each student complete and uninterrupted access to the equipment for that day's lab work.

Data collection is only one part of the physical chemistry laboratory, and considerable time will be spent with data analysis. The data analysis will range from using basic quantum mechanical models that can be mathematically solved by hand, to the application of advanced computational chemistry methods using research-grade software packages.

*****Students are to maintain a single laboratory notebook in which they record their experimental work.***** These notebooks must be standard laboratory notebooks that have a binding (no loose leaf or spiral binding) and "composition" style notebooks are acceptable. Notebooks must be kept up to date. After completing their laboratory work for the day and before leaving the laboratory, each student must have their TA initial the data newly recorded in the notebook. The quality and completeness of the laboratory notebook is an important part of your final grade. An additional incentive to keep a tidy notebook is that your lab notebook can be used as part of your personal notes when taking exams.

WEDNESDAY (M004) Laboratory Detailed Meeting Schedule

Date	Student 1	Student 2	Student 3	Student 4	Student 5	Student 6	Student 7
	2:15pm – 3:05pm			3:15pm – 4:05pm		4:15pm – 5:05pm	
Feb 10	No lab	No lab	No lab	No lab	No lab	No lab	No lab
Feb 17	Lab training	Lab training	Lab training	Lab training	Lab training	Lab training	Lab training
Feb 24	Comp. Chem. training	Comp. Chem. training	Comp. Chem. training	Comp. Chem. training	Comp. Chem. training	Comp. Chem. training	Comp. Chem. training
Mar 3	Lab A	Lab B	Lab C	Lab A	Lab B	Lab A	Lab B
Mar 10	Lab B	Lab C	Lab A	Lab B	Lab C	Lab B	Lab C
Mar 17	Lab C	Lab A	Lab B	Lab C	Lab A	Lab C	Lab A
Mar 24	Make-up	Make-up	Make-up	Make-up	Make-up	Make-up	Make-up
Mar 31	No lab: in-class exam #1	No lab: in-class exam #1	No lab: in-class exam #1	No lab: in-class exam #1	No lab: in-class exam #1	No lab: in-class exam #1	No lab: in-class exam #1
Apr 7	Lab D	Lab F	Lab E	Lab D	Lab F	Lab D	Lab F
Apr 14	Lab E	Lab D	Lab F	Lab E	Lab D	Lab E	Lab D
Apr 21	Lab F	Lab E	Lab D	Lab F	Lab E	Lab F	Lab E
Apr 28	No lab – wellness day	No lab – wellness day	No lab – wellness day	No lab – wellness day	No lab – wellness day	No lab – wellness day	No lab – wellness day
May 5	Make-up	Make-up	Make-up	Make-up	Make-up	Make-up	Make-up
May 12	No lab: in-class exam #2	No lab: in-class exam #2	No lab: in-class exam #2	No lab: in-class exam #2	No lab: in-class exam #2	No lab: in-class exam #2	No lab: in-class exam #2

THURSDAY (M003) Laboratory Detailed Meeting Schedule

Date	Student 8	Student 9	Student 10	Student 11	Student 12	Student 13	Student 14
	2:00pm – 2:50pm			3:00pm – 3:50pm		4:00pm – 4:50pm	
Feb 11	No lab	No lab	No lab	No lab	No lab	No lab	No lab
Feb 18	Lab training	Lab training	Lab training	Lab training	Lab training	Lab training	Lab training
Feb 25	Comp. Chem. training	Comp. Chem. training	Comp. Chem. training	Comp. Chem. training	Comp. Chem. training	Comp. Chem. training	Comp. Chem. training
Mar 4	Lab A	Lab B	Lab C	Lab A	Lab B	Lab A	Lab B
Mar 11	Lab B	Lab C	Lab A	Lab B	Lab C	Lab B	Lab C
Mar 18	Lab C	Lab A	Lab B	Lab C	Lab A	Lab C	Lab A
Mar 25	Make-up	Make-up	Make-up	Make-up	Make-up	Make-up	Make-up
Apr 1	No lab: in-class exam #1	No lab: in-class exam #1	No lab: in-class exam #1	No lab: in-class exam #1	No lab: in-class exam #1	No lab: in-class exam #1	No lab: in-class exam #1
Apr 8	Lab D	Lab F	Lab E	Lab D	Lab F	Lab D	Lab F
Apr 15	Lab E	Lab D	Lab F	Lab E	Lab D	Lab E	Lab D
Apr 22	Lab F	Lab E	Lab D	Lab F	Lab E	Lab F	Lab E
Apr 29	No lab – wellness day	No lab – wellness day	No lab – wellness day	No lab – wellness day	No lab – wellness day	No lab – wellness day	No lab – wellness day
May 6	Make-up	Make-up	Make-up	Make-up	Make-up	Make-up	Make-up
May 13	No lab: in-class exam #2	No lab: in-class exam #2	No lab: in-class exam #2	No lab: in-class exam #2	No lab: in-class exam #2	No lab: in-class exam #2	No lab: in-class exam #2

List of Laboratory Experiments with Key Learning Objectives

Lab A: Polarimetry Measurement of the Inversion of Sucrose, TA: Alec Beaton

- Demonstration of the fundamental composition of light
- Molecular chirality and light interaction
- Measurement of reaction kinetics

Lab B: Powder X-ray Diffraction of Metal Oxides, TA: Margaret Davis

- Application of Bragg's law
- Demonstration of diffraction of electromagnetic waves
- Measurement of atomic-level parameters in a compound
- Note: Due to X-ray radiation safety rules, experimental data is provided to students.

Lab C: Infrared and Raman Spectroscopy of Molecular Solids, TA: Margaret Davis

- Demonstration of the harmonic oscillator quantum model
- Application of different vibrational selection rules
- Assignment and use of molecular symmetry

Lab D: Electronic Absorption and Fluorescence of Polycyclic Aromatics in Solution, TA: Alec Beaton

- Demonstration of the particle-in-a-box quantum model
- Coexistence of electronic and vibrational spectral information
- Fate of absorbed photons – Emission spectra

Lab E: Raman Spectroscopy of Liquids, TA: Margaret Davis

- Normal modes of vibration of complex polyatomic molecules
- Boltzmann distribution of isomer populations
- Signal-to-noise and detection limits in spectroscopy

Lab F: Rotational Raman Spectroscopy of the Atmosphere, TA: Alec Beaton

- Demonstration of the rigid rotor quantum model
- Advanced factors in spectral intensities: nuclear spin statistics and Boltzmann distribution
- Measurement of atomic-level parameters in a compound
- Note: Due to exposed laser radiation safety rules, experimental data is provided to students.

Lab Lecture Meeting Schedule

*****All students attend the in-person lab lecture at the same time (unlike the lab practical work).*****

A lab lecture will be held on Monday of most weeks (2:15pm to 3:35pm in Carnegie Library Room 219) and will be led by Prof. Korter. The lecture will serve as a review of the underlying quantum mechanics you will be investigating in the laboratory experiments, as well as provide insight into the operation of the various instruments being used.

The following is a list of lecture dates and *approximate subject coverage* for each meeting.

- Feb 8 – Syllabus, Introduction, Overview of all laboratories
- Feb 15 – Principles of light, Absorption, Scattering, Diffraction
- Feb 22 – Quantum models and Computational chemistry
- Mar 1 – Spectroscopic techniques, Selection rules, Symmetry
- Mar 8 – Spectrometer components and operation, Lasers
- Mar 15 – Signal-to-noise, Statistics, Line shapes
- Mar 22 – Review session (optional)
- Mar 29 – **Exam #1** – essay questions with open notes
- Apr 5 – Electronic spectroscopy – Particle-in-a-box
- Apr 12 – Vibrational spectroscopy – Harmonic oscillator
- Apr 19 – Rotational spectroscopy – Rigid rotor
- Apr 26 – **NO LECTURE**
- May 3 – Review session (optional)
- May 10 – **Exam #2** – essay questions with open notes

Overall Course Grading

Your final overall course grade is based on your earned scores in the laboratory reports (60% of total grade), laboratory preparation & execution (20% of total grade), and exams (20% of total grade). **There is no “final” exam in this course.**

The **laboratory reports** are due one week after the laboratory activity takes place. They are turned in via the course Blackboard site at <http://blackboard.syr.edu> (CHE.357.M001) and specific instructions will be provided to you at your first laboratory meeting. These reports will be based on a provided “template” for each laboratory that will include various sections such as (but not limited to) the presentation of acquired data, the application of fundamental quantum mechanical models, the use of computational chemistry in data interpretation, and the critical analysis of your findings. While collaborative work with other students to improve your understanding of difficult subjects is strongly encouraged, each student must turn in an individually prepared lab report, where the data collection, data analysis, and overall final presentation must be the product of one student. **Plagiarism will not be tolerated.**

Late lab reports will be accepted, but penalties will be applied. A 10-point score reduction (each lab report is worth 100 points) will be applied to the graded score for each day the report is late. Even a report received one minute past the deadline will be considered to be one day late.

*****Lab reports received later than 1 week will not be graded and will automatically receive a score of zero.*****

The **laboratory preparation & execution grade** is based upon the student's level of involvement with the experiment, safety, cleanliness, behavior, attention to instruction, and the quality of their lab notebook contents. This score will be assigned by the TA overseeing that week's experiment.

There will be two **exams** administered during the lab lecture times on March 29 and May 10. Exams will cover both material covered in lecture and the laboratory activities. The exams are essay question based and open notes. “Notes” consist of information that you personally have gathered from whatever sources you wish, including your laboratory notebook and material provided by the TAs and Prof. Korter. **Academic honesty is expected of each of you.** You may not use any external resources during exams such as websites, search engines, social media, etc.

*****There will be no “extra credit” offered in this course.*****

GENERAL SYRACUSE UNIVERSITY COURSE POLICIES

STAY SAFE PLEDGE AND EXPECTATIONS IN THE CLASSROOM

Syracuse University's Stay Safe Pledge reflects the high value that we, as a university community, place on the well-being of our community members. This pledge defines norms for behavior that will promote community health and wellbeing. Classroom expectations include the following: wearing a mask that covers the nose and mouth at all times, maintaining a distance of six feet from others, and staying away from class if you feel unwell. Students who do not follow these norms will not be allowed to continue in face-to-face classes; repeated violations will be treated as violations of the Code of Student Conduct and may result in disciplinary action.

FOOD AND DRINK IN THE CLASSROOM

Eating and drinking require the lowering of the face mask, creating a potentially dangerous situation. For this reason, students are not allowed to eat or drink in class during the COVID-19 pandemic.

USE OF CLASS MATERIALS AND RECORDINGS

Original class materials (handouts, assignments, tests, etc.) and recordings of class sessions are the intellectual property of the course instructor. You may download these materials for your use in this class. However, you may not provide these materials to other parties (e.g., web sites, social media, other students) without permission. Doing so is a violation of intellectual property law and of the student code of conduct.

ACADEMIC INTEGRITY

Syracuse University's Academic Integrity Policy reflects the high value that we, as a university community, place on honesty in academic work. The policy defines our expectations for academic honesty and holds students accountable for the integrity of all work they submit. Students should understand that it is their responsibility to learn about course-specific expectations, as well as about university-wide academic integrity expectations. The policy governs appropriate citation and use of sources, the integrity of work submitted in exams and assignments, and the veracity of signatures on attendance sheets and other verification of participation in class activities. The policy also prohibits students from submitting the same work in more than one class without receiving written authorization in advance from both instructors. Under the policy, students found in violation are subject to grade sanctions determined by the course instructor and non-grade sanctions determined by the School or College where the course is offered as described in the Violation and Sanction Classification Rubric. Syracuse University students are required to read an online summary of the University's academic integrity expectations and provide an electronic signature agreeing to abide by them twice a year during pre-term check-in on MySlice.

All academic integrity expectations that apply to in-person quizzes and exams also apply to online quizzes and exams. In this course, all work submitted for quizzes and exams must be yours alone. Discussing quiz or exam questions with anyone during the quiz or exam period violates academic integrity expectations for this course."

Using websites that charge fees or require uploading of course material (e.g. Chegg, Course Hero) to obtain exam solutions or assignments completed by others and present the work as your own violates academic integrity expectations in this course."

The Violation and Sanction Classification Rubric establishes recommended guidelines for the determination of grade penalties by faculty and instructors, while also giving them discretion to select the grade penalty they believe most suitable, including course failure, regardless of violation level. Any established violation in this course may result in course failure regardless of violation level.

EMAIL POLICY

Syracuse University has established email as a primary vehicle for official communication with students, faculty, and staff. An official email address is established and assigned by Information Technology Services (ITS) for each registered student, as well as for all active faculty and staff members. All University communications sent via email will be sent to this address. Faculty and staff members must use the officially established University email address to communicate with students registered in their classes.

FAITH TRADITION OBSERVANCES

Syracuse University's religious observances policy (<https://policies.syr.edu/policies/university-governance-ethics-integrity-and-legal-compliance/religious-observances-policy/>) recognizes the diversity of faiths represented in the campus community and protects the rights of students, faculty, and staff to observe religious holy days according to their traditions. Under the policy, students should have an opportunity to make up any examination, study, or work requirements that may be missed due to a religious observance provided they notify their instructors no later than the end of the second week of classes for regular session classes and by the

submission deadline for flexibility formatted classes. Student deadlines are posted in MySlice under Student Services/Enrollment/My Religious Observances/Add a Notification.

STUDENT MENTAL HEALTH

Mental health and overall well-being are significant predictors of academic success. As such, it is essential that during your college experience you develop the skills and resources effectively to navigate stress, anxiety, depression, and other mental health concerns. Please familiarize yourself with the range of resources the Barnes Center provides (<https://ese.syr.edu/bewell/>) and seek out support for mental health concerns as needed. Counseling services are available 24/7, 365 days, at 315-443-8000.

DISCRIMINATION OR HARASSMENT

The University does not discriminate and prohibits harassment or discrimination related to any protected category including creed, ethnicity, citizenship, sexual orientation, national origin, sex, gender, pregnancy, disability, marital status, age, race, color, veteran status, military status, religion, sexual orientation, domestic violence status, genetic information, gender identity, gender expression or perceived gender.

Any complaint of discrimination or harassment related to any of these protected bases should be reported to Sheila Johnson-Willis, the University's Chief Equal Opportunity & Title IX Officer. She is responsible for coordinating compliance efforts under various laws including Titles VI, VII, IX and Section 504 of the Rehabilitation Act. She can be contacted at Equal Opportunity, Inclusion, and Resolution Services, 005 Steele Hall, Syracuse University, Syracuse, NY 13244-1120; by email: titleix@syr.edu; or by telephone: 315-443-0211.

DISABILITY ACCOMMODATIONS

Syracuse University values diversity and inclusion; we are committed to a climate of mutual respect and full participation. There may be aspects of the instruction or design of this course that result in barriers to your inclusion and full participation in this course. I invite any student to contact me to discuss strategies and/or accommodations (academic adjustments) that may be essential to your success and to collaborate with the Center for Disability Resources (CDR) in this process.

If you would like to discuss disability-accommodations or register with CDR, please visit Center for Disability Resources (<https://disabilityservices.syr.edu/>). Please call (315) 443-4498 or email disabilityresources@syr.edu for more detailed information.

The CDR is responsible for coordinating disability-related academic accommodations and will work with the student to develop an access plan. Since academic accommodations may require early planning and generally are not provided retroactively, please contact CDR as soon as possible to begin this process.

ATTENDANCE POLICY (INCLUDING ABSENCE NOTIFICATION)

Attendance in classes is expected in all courses at Syracuse University.

Students may contact their home school/college Dean's Office or the Case Management staff in Dean of Students Office (315.443.4357, DOS@syr.edu) when they are absent from class for an extended period of time (48 hours or more). The Case Management staff will require documentation for the absence and will utilize Orange SSuccess to send notifications to faculty to verify that documentation has been received for the stated absence.

Barnes Center at the Arch (Health, Counseling, etc.) staff will not provide medical excuse notes for students. When Barnes Center staff determine it is medically necessary to remove a student from classes, they will coordinate with the case management staff to provide absence notification to faculty through Orange Success. For absences lasting less than 48 hours, students are encouraged to discuss academic arrangements directly with their faculty.

Additional information may be found through the Dean of Students Office: Absence Notifications (<https://ese.syr.edu/dean-of-students/services/>)