

ANALYTICAL SPECTROSCOPY

CHEMISTRY 7140

SPRING SEMESTER 2025

Lecture time (in-person): Mon/Wed/Fri 12:40 PM – 1:35 PM

Location: Caldwell Laboratory 0137

Instructor

Robert Baker

Email: Baker.2364@osu.edu

Office: 2110 Newman-Wolfrom

Office Hours: Monday, 3:00–4:00 PM or by appointment

Preference is for in-person office hours. However, I may be available to meet via virtually upon request when arranged in advance. Link for Zoom office hours below:

Zoom link: <https://osu.zoom.us/j/92682115667?pwd=ScyVoUKkUrJbHr9gs7kF1JPKbexE4S.1>

Meeting ID: 926 8211 5667

Password: 424346

Teaching Assistant

Jaclyn Rebstock

Email: Rebstock.4@buckeyemail.osu.edu

Office Hours: Tuesday, 2:00 PM – 3:00 PM and Friday, 11:30 AM – 12:30 PM

Location: TBD

Course Objective and Learning Outcomes

To provide a foundation in the theory, applications, and instrumentation of atomic, molecular, and solid-state spectroscopy. This foundation will enable students to interpret spectroscopic data and to know which type of experiment can be employed to answer specific questions. Also, to provide an understanding of current experimental capabilities and limitations. This understanding will guide students in research-related experimental planning and design.

Textbooks (*The texts below will serve as helpful resources, but are not required for this course*)

Primary Textbooks

- *Modern Spectroscopy* (4th Ed.) by J. Michael Hollas
- *Solid State Spectroscopy* (2nd Ed.) by Hans Kuzmany

Supporting Textbooks

- *Molecular Spectroscopy* by Jeanne L. McHale
- *Spectrochemical Analysis* by James D. Ingle and Stanley R. Crouch
- *Nonlinear Optics* (3rd Ed.) by Robert W. Boyd

Class Schedule

Homework

Homework sets will be assigned on a regular basis. These assignments will be submitted using Carmen. You are encouraged to share your ideas and work together on these assignments, but *DO NOT* copy solutions. Late assignments will not be accepted.

Literature Reading

A paper related to lecture material will be assigned for reading approximately every 1-2 weeks. These papers will be reviewed in lecture on a specified date, and a short in-class quiz will be given at the start of the class.

Midterm Exams

There will be 2 midterm exams. The first will be scheduled the week of February 17, and the second will be scheduled the week of March 24. Midterm exams will be held on a weekday evening outside of class.

Research Proposal

A term paper and associated oral report will serve in place of the final exam. The goal is for you to apply something that you learn in this course to a research question of interest to you. Additional instructions will follow.

Topic abstracts will be due on Monday, March 3.

Written reports will be due on Monday, April 7.

Oral presentations will be presented in class beginning on or around Monday, April 7.

Grades

Homework Sets	20%
Reading Quizzes	10%
Midterm Exam 1	20%
Midterm Exam 2	20%
Written Report	20%
Oral Presentation	10%

Lecture Topics

- I. Light–Matter Interactions
 - A. Classical Nature of Light and Maxwell’s Equations
 - B. Review of Quantum Mechanics and Fermi’s Golden Rule
 - C. Lineshapes and Broadening
- II. Dielectric Functions
 - A. Fresnel Coefficients and Evanescent Waves
 - B. Real and Imaginary Components of a Complex Refractive Index
 - C. Transmission vs. Reflection Spectroscopy
- III. Instrumentation
 - A. Light Sources
 - B. Optics and Monochromators
 - C. Detectors
 - D. Noise Analysis and Frequency Modulation
 - E. Fourier Transform Spectroscopy
- IV. Types of Spectroscopy
 - A. Symmetry and Group Theory
 - B. Rotational, Vibrational, and Electronic Transitions
 - C. Term Symbols and Selection Rules

Academic Integrity and Academic Misconduct

Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University and the Committee on Academic Misconduct (COAM) expect that all students have read and understand the university’s [Code of Student Conduct](#) (studentconduct.osu.edu), and that all students will complete all academic and scholarly assignments with fairness and honesty. Students must recognize that failure to follow the rules and

guidelines established in the university's *Code of Student Conduct* and this syllabus may constitute "Academic Misconduct."

If I suspect that a student has committed academic misconduct in this course, I am obligated by university rules to report my suspicions to the Committee on Academic Misconduct. If COAM determines that you have violated the university's Code of Student Conduct (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in this course and suspension or dismissal from the university.

If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact me.

Artificial Intelligence

In this course, students are welcome to explore innovative tools and technologies, including generative artificial intelligence (GenAI). Students are permitted to use GenAI tools for most course assignments, except for your proposal abstract and your written proposal report. These written assignments should represent your own original work.

Diversity and Inclusion

The Department of Chemistry and Biochemistry promotes a welcoming and inclusive environment for all students and staff, regardless of race, gender, ethnicity, national origin, disability or sexual orientation. There is no tolerance for hateful speech or actions. All violations of this policy should be reported to the OSU Bias Assessment and Response Team (BART, studentaffairs.osu.edu/bias).

The Department encourages diversity at all levels, particularly among the next generation of scientists. Students are encouraged to participate in organizations that provide support specifically for science and engineering students who are African-American, Asian, disabled, Hispanic, LGBTQ or women. These organizations are listed on the Colleges of Arts and Sciences (artsandsciences.osu.edu/stem-organizations) and Engineering (engineering.osu.edu/studentorgs) web sites.

Disability Services

Disability Services (ODS): All students with documented disabilities, who need accommodations, should see the instructor privately. If your disability requires materials in alternative formats, please contact the Office for Disability Services (ODS), 1760 Pomerene Hall 292-3307

Health and Safety

Health and safety requirements: All students, faculty and staff are required to comply with and stay up to date on all university safety and health guidance (<https://safeandhealthy.osu.edu>), which includes wearing a face mask in any indoor space and maintaining a safe physical distance at all times. Non-compliance will result in a warning first, and disciplinary actions will be taken for repeated offenses.

Student Wellness

As a student, you may experience a range of issues that can cause barriers to learning such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. No matter where you are engaged in distance learning, The Ohio State University's Student Life Counseling and Consultation Service (CCS) is here to support you. If you find yourself feeling isolated, anxious or overwhelmed, on-demand resources are available at go.osu.edu/ccsondemand. You can reach an on-call counselor when CCS is closed at 614-292-5766, and 24-hour emergency help is also available through the 24/7 National Prevention Hotline at 1-800-273-TALK or at suicidepreventionlifeline.org. The Ohio State: Wellness app is also a great resource.

Resources for students are included on the [Ohio State: Wellness app](#). The Ohio State: Wellness app is designed for students but offers tips and guidance useful for all members of our community. It is available for [Android](#) and [iOS](#) devices.

The university has also created a site to assist students as they adapt to this new virtual environment: [Keep Learning OS](#).