

## CHEM 304: Integrated Physical and Analytical Laboratory II

Instructor <i>TA</i>	Day	Email	Office	Office Hours
Kristin Wustholz <i>Huw Richards</i>	Monday	<a href="mailto:kwustholz@wm.edu">kwustholz@wm.edu</a>	ISC 2041	Wed 2:00–3:00
Nathan Kidwell <i>Jacob Blackshaw</i>	Tuesday	<a href="mailto:nmkidwell@wm.edu">nmkidwell@wm.edu</a>	ISC 1287	Mon 11:00–12:30
Jeff Molloy <i>Emma Walhout</i>	Wednesday	<a href="mailto:jcmolloy@wm.edu">jcmolloy@wm.edu</a>	ISC 2031	By appointment
Tyler Meldrum* <i>Sophie Padilla</i>	Thursday	<a href="mailto:tkmeldrum@wm.edu">tkmeldrum@wm.edu</a>	ISC 1060	Wed 11:00–12:30

*Other office hours by appointment with the instructor.*

*\*Prof. Meldrum is responsible for course administration, including schedule changes and gradekeeping.*

### Course Description

By measuring physical properties and processes, thoughtfully interpreting data, and developing laboratory and communication skills, you will put the concepts of physical chemistry into practice. The course is organized around three main units: *Data*, *Theory*, and *Change*. In *Data*, you will explore and analyze data, considering sources of error and the limitations of your conclusions. In *Theory*, you will explore the behavior of matter from the microscopic (quantum) to the macroscopic (thermodynamic) realm. In *Change*, you will examine dynamic processes such as chemical reactions and transformations.

During our weekly meetings, we will collect and analyze data, evaluate models, create compelling figures, and practice scientific writing.

### Learning Objectives

At the end of this course, as active participants in the learning and communicating process, you will be able to:

- Understand and apply fundamental concepts in physical chemistry.
- Examine a chemical problem and develop an approach to address it.
- Identify sources of error and limitations of data.
- Evaluate uncertainty in order to draw reasonable conclusions.
- Design effective plots and figures in order to illustrate experimental findings.
- Compose written reports that effectively describe and evaluate experimental findings.
- Create a coherent product that accurately and responsibly communicates your conclusions.

**Grading**

Your grade in CHEM 304 comprises the following components:

*Formal submissions (45% total):*

You will submit five (5) lab reports (or parts of lab reports) during the semester. Each of these reports will be slightly different and specific requirements are detailed in the corresponding entries in the lab manual. These are associated with:

- *Thermal analysis of Liquid Crystals* (due approximately February 4–7)
- *Quantifying Barriers to Hindered Rotation* (due approximately February 25–28)
- *Electronic, Vibrational, and Rotational Coupling* (due approximately March 18–21)
- *Unimolecular Decomposition* (due approximately April 1–4)
- *FRET in cytochrome-c* (due approximately April 15–18)

*Peer-review (5%):*

The final lab report will be peer-reviewed by class members. Your participation in reviewing others' work will contribute 5% to your final course grade. The grade you receive on the final lab report is separate from the peer-review score.

*Lab citizenship (10%):*

A lab citizenship score will be assigned by the course instructors. Good lab citizenship includes coming to lab prepared with the appropriate materials in hard copy, your computer, personal protective equipment as needed, and working appropriately with your lab partner.

*In-class exercises and worksheets (30% total):*

Most weeks there will be in-class activities in your lab manual. These will be completed by you, often together with your lab partner, and will be checked by the instructor or the TA during class. Each exercise will be graded pass/fail. For an example activity, see page 11 in Unit 1.

*Lab notebooks (10%):*

Your lab notebooks will be checked by an instructor/TA each week before you leave. Not only is this a check that you're using a lab notebook appropriately and that you'll have sufficient data to write up your reports but is an essential habit for research scientists. Confirmation of research is essential in the scientific process, and the lab notebook is the record that allows an experiment to be repeated. Record important things that happen in lab, including unexpected events, filenames for saved data, important observations, and other information as needed to thoroughly record your experience during the experiment. You will receive a weekly pass/fail grade.

**Guidelines for Lab Partners**

Team skills are an essential part of chemistry. The American Chemical Society (ACS) recommends learning how to interact effectively with a diverse group of peers to solve scientific problems. These team skills are as important as the chemistry content, laboratory techniques, and safety skills that you will be learning in the lab this semester. Lab partners, classmates, teaching assistants, faculty, and staff are expected to create an environment of mutual respect and

cooperation. Everyone is expected to practice these team skills, conduct lab procedures safely, and maintain respect for the abilities of others.

**SAS Statement**

William & Mary accommodates students with disabilities in accordance with federal laws and university policy. Any student who feels they may need an accommodation based on the impact of a learning, psychiatric, physical, or chronic health diagnosis should contact Student Accessibility Services staff at 757-221-2512 or at [sas@wm.edu](mailto:sas@wm.edu) to determine if accommodations are warranted and to obtain an official letter of accommodation. For more information, please see [www.wm.edu/sas](http://www.wm.edu/sas).

**Writing Resources Center**

The Writing Resources Center, located on the first floor of Swem Library, is a free service provided to W&M students. Trained consultants offer individual assistance with writing, presentation, and other communication assignments across disciplines and at any stage, from generating ideas to polishing a final product. To make an appointment, visit [www.wm.edu/wrc](http://www.wm.edu/wrc).

**Tentative Schedule (as of 7 January 2019 and subject to change)**

Dates	Unit	Week	Topic <i>Experiment (if applicable)</i>	Submissions due
1/24			Evening meeting (6 pm, ISC 1127)	
1/28-1/31	<b>I. DATA</b>	1	Working with data, correcting baselines <i>Thermal analysis of liquid crystals</i>	
2/4-2/7		2	Visualizing data, making figures <i>Quantifying barriers to hindered rotation</i>	Figure and short write-up: <i>Thermal analysis of liquid crystals</i>
2/11-2/14		3	Uncertainty and error propagation	
2/18-2/21		4	Writing lab reports	
2/25-2/28	<b>II. THEORY</b>	5	Electronic spectroscopy <i>UV-Vis absorption and emission spectra</i>	Complete lab report: <i>Quantifying barriers to hindered rotation</i>
3/4-3/7			Spring break	
3/11-3/14	<b>II. THEORY</b>	6	Vibrational and rotational spectroscopy <i>HCl-DCl</i>	
3/18-3/21		7	Energy level populations <i>Speed of sound</i>	Complete lab report: <i>Coupling (electronic, vibrational, rotational)</i>
3/25-3/28	<b>III. CHANGE</b>	8	Chemical kinetics <i>Unimolecular decomposition</i>	
4/1-4/4		9	Biophysical method: fluorescence <i>FRET in cytochrome-c</i>	Data workup: <i>Unimolecular decomposition</i>
4/8-4/11		10	Peer review	[ungraded] Draft lab report: <i>FRET in cytochrome-c</i>
4/15-4/18		11	Course end, summary	Post peer-review lab report: <i>FRET in cytochrome-c</i>