



Course	CHEM 4473.002 / Physical Measurements Laboratory
Instructor	Dr. Yu(Tony) Huang
Term	Spring, 2025
Meetings	MW 8:30 am – 9:45 am, SLC 1.204 (Lecture) MW 9:45 am – 12:45 pm SLC 3.203(Lab)

Instructor's Contact Information

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Office Hour	By appointment / Teams
Other Information	<p style="text-align: center;"><u>Graduate Student Teaching Assistants (TAs)</u></p> Erling Beck Erling.Beck@utdallas.edu Emily Brand ejc200000@utdallas.edu Hyunseo(Erin) Kim hyunseo.kim2@utdallas.edu

General Course Information

Pre-requisites & other restrictions	CHEM 2401 Quantitative Analysis, ChEM 3472, Instrumental Analysis and CHEM 3321. No students will be allowed to remain in the course without passing these prerequisites as basic knowledge of data handling and instrumentation is essential for successful completion of the course. It is also strongly suggested that you be enrolled in or have taken CHEM 3322
Course Description	This course emphasizes the techniques and results of physical measurements and the growth and emerging maturity of senior (bio)chemistry majors as young professional scientists. Modules may include topics in physical chemistry and biophysics such as nanotechnology, calorimetry, computational methods, kinetics, literature skills, properties of matter, spectroscopy, and statistical methods.
Required Texts & Materials	“Experiments in Physical Chemistry”, by C.W. Garland, J.W. Nibler, D.P. <ul style="list-style-type: none">• Shoemaker, McGraw-Hill, 8th edition or later, ISBN 978-0-07-282842-9 or ISBN-10 : 1259511472 Lab Book: “Roaring Springs Composition Book”, Quad. Rules 5 to 1”, Bar Code 71072 77255, or any other quadrule hardcover notebook.

<p>Supplemental Materials</p>	<p><i>Physical Chemistry</i>; 2006; by Thomas Engel and Philip Reid (E&R); ISBN 08053-3842-X or any other comprehensive physical chemistry textbook. <i>Undergraduate Instrumental Analysis</i>; 2005; by James W. Robinson, Eileen M. Skelly Frame and George M. Frame II (RFF); ISBN0-8247-5359-3. <i>Physical Chemistry; A Molecular Approach</i>; by Donald A. McQuarrie and John D. Simon (McQ); 1997; ISBN 978-0-935702-99-6.</p>
<p>Learning Objectives/Outcomes</p>	<ol style="list-style-type: none"> 1. Deep Understanding of fundamental physical chemical principles through hand-on experiences. 2. Critical Thinking (CT)—to include how to use the physical chemistry to conduct creative thinking, innovation, inquiry, and analysis, evaluation, and synthesis of information 3. Communication (COM)-to include effective development, interpretation, and expression of ideas through written, oral, and visual communication 4. Empirical and Quantitative Skills (EQS)-to include the manipulation and analysis of numerical data or observable facts resulting in informed conclusions 5. Teamwork (TW)-to include the ability to consider different points of view and to work effectively with others to support a shared purpose or goal

Table I. Nominal Lecture Schedule

Date	Day	Topic	Reading
22-Jan	Wed	Course overview	GNS Ch 1-2
27-Jan	Mon	Lab Notebook, Lab Reports	handout
29-Jan	Wed	Statistics, error propagation	E&R Ch 34, GNS Exp 27
3-Feb	Mon	Calorimetry; heats of combustion and formation	McQ Ch 19, GNS Exp 6
5-Feb	Wed	Partial molar volumes	GNS Ex 9
10-Feb	Mon	Elementary Kinetics	McQ Ch 28
12-Feb	Wed	Light and spectroscopy	RFF Ch 2, handout
17-Feb	Mon	CD spectroscopy; ΔH of protein unfolding	E&R 25.13; McQ 26-7
19-Feb	Wed	CD spreadsheet calculations	E&R 25.13; McQ 26-7
24-Feb	Mon	A quantum view of matter; particle in a box	McQ Ch 3
26-Feb	Wed	Molecular absorption and fluorescence	RFF Ch 5; E&R Ch 25, 27
3-Mar	Mon	Molecular absorption and fluorescence	
5-Mar	Wed	Review for midterm exam	
10-Mar	Mon	Midterm exam	
12-Mar	Wed	Harmonic and anharmonic oscillator	McQ Ch5
17-Mar	Mon	Spring Break	
19-Mar	Wed	Spring Break	
24-Mar	Mon	Rotational spectroscopy; effect of distortion	McQ Ch 5, RFF Ch 13
26-Mar	Wed	Light scattering and zeta potential	
31-Mar	Mon	Deadline for submitting presentation topic	
2-Apr	Wed	Light scattering and zeta potential	
7-Apr	Mon	FT NMR and the rotating frame	E&R Ch 28
9-Apr	Wed	Acquisition time, pulse width, recycle time	E&R Ch 28
14-Apr	Mon	NMR relaxation times, how fast to recycle?	E&R Ch 28
16-Apr	Wed	Presentation	
21-Apr	Mon	Presentation	
23-Apr	Wed	Presentation	
28-Apr	Mon	Presentation	
30-Apr	Wed	Presentation	
5-May	Mon	Presentation	
7-May	Wed	Presentation	
12-May to 16-May		Final exam	

Course Policies

Laboratory Modules	<p>Each student will perform 8 experimental laboratory modules and submit 8 laboratory reports. Due to the diversity of topics and the limited time available for lectures you may be required to carry out many experiments prior to the lecture dates listed in Table I in which the background material is covered in class. In these cases you are responsible for acquainting yourself with the background and theory necessary to perform and write-up the modules prior to the in-class lectures.</p> <p>Table II</p> <table border="1" data-bbox="375 499 1442 1255"><thead><tr><th>No.</th><th>Exp</th><th>Description</th><th>page</th></tr></thead><tbody><tr><td>1</td><td>25</td><td>Partial molar volumes</td><td>172</td></tr><tr><td>2</td><td>handout</td><td>protein denaturation equilibria (CD)</td><td>handout</td></tr><tr><td>3</td><td>handout</td><td>kinetics of methylene blue oxidation</td><td>handout</td></tr><tr><td>4</td><td>7</td><td>bomb calorimetry</td><td>152</td></tr><tr><td>5</td><td>23, handout</td><td>Light scattering, zeta potential</td><td>379, handout</td></tr><tr><td>6</td><td>34</td><td>Absorption of a conjugated dye</td><td>393</td></tr><tr><td>7</td><td>37</td><td>Rot-vib spectra of HCl/DCl</td><td>416</td></tr><tr><td>8</td><td>handout</td><td>NMR S/N optimization</td><td>handout</td></tr></tbody></table> <p>A schedule of which students carry out each of the modules on which dates will be provided by the instructor. (APPENDIX A).</p> <p>Most experiments are from the textbook. Handouts will be provided for those experiments not in the text. In addition, supplemental material may be provided for experiments out of the text and in some cases, modifications may be made to the experiments in the text.</p>	No.	Exp	Description	page	1	25	Partial molar volumes	172	2	handout	protein denaturation equilibria (CD)	handout	3	handout	kinetics of methylene blue oxidation	handout	4	7	bomb calorimetry	152	5	23, handout	Light scattering, zeta potential	379, handout	6	34	Absorption of a conjugated dye	393	7	37	Rot-vib spectra of HCl/DCl	416	8	handout	NMR S/N optimization	handout
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Lab Safety	<p>IMPORTANT: In accordance with University and Chemistry Department safety rules, any time anyone (student, TA, instructor, or visitor) is in a lab, Z87-rated safety eyewear must be worn. The first violation in the semester will result in a warning and removal from the lab until the safety eyewear is in-place. The second violation in the semester will result in dismissal from that lab period with no extra time being allowed for make-up of the work scheduled for that lab period. Similar penalties will apply if any other safety rules are violated. In summary, all students are responsible for all information inside the undergraduate safety manual; it is located at: www.utdallas.edu/nsm/chemistry/resources/safety.html In addition, please refer to Dr.P.'s supplemental handout concerning optical and electrical safety issues.</p> <p>We now have lab coats that are cleaned after each lab period.</p>																																				

<p style="text-align: center;">Lab Technique</p>	<p>Each student will be evaluated with respect to their adherence to good safety practices, laboratory technical skills, and laboratory etiquette/professionalism. The evaluations will be made by the instructor and TAs at the end of each module and included in the lab report grade.</p>
<p style="text-align: center;">Lab Reports</p>	<p>Each student must prepare his or her own lab report for each of the 8 experimental modules based on the guidelines described in Chapter 1 of the text. All lab reports must be typed. Data sections should include graphs and tables of tabulated results as well as a narrated interpretation of the data. Calculations may be carried out with a spreadsheet and included in the appendix of the report. The appendix should also include copies of relevant notebook pages and raw graphical data. A 'good' Lab Report comprises quality science/data, quality arguments/discussion, and a complete appendix with an appropriately kept notebook. Discussions should contrast your results to relevant data from the scientific literature. (see online instruction of report writing) Lab reports must be submitted online through Turnitin on or before midnight on the due date (APPENDIX). There is no penalty for turning in your report early. This will act as a time stamp to verify when you turned in your report. Turnitin will also be used to verify the originality of the report. <u>In order to properly submit the Turnitin copy you must not only upload your file but also click confirm, after which you will get confirmation that your digital copy has been submitted. Failure to click confirm will result in your report not being submitted. Students have 12 days after they finish their labs on Wednesday to complete and turn in their lab reports. There are no "late reports". Any lab report not turned in before midnight on the due date will be given a score of 0.</u> Students are not allowed to "jump ahead" in performing their experiments as this creates logistical problems in terms of adequate equipment and TA help. <u>Issues on grading of reports should be brought to the attention of the TA or instructor within one week of you receiving your returned graded report.</u> Your lab reports count for 50% of your grade so it is essential these be turned in on time in order for you to do well in CHEM 4473.</p>
<p style="text-align: center;">Lab Notebooks</p>	<p>Each student must bring his or her lab notebook to Berkner every Monday and Wednesday. Failure to do so means that the student is not ready to carry out an experiment and he/she will be asked to leave the lab until the notebook can be retrieved. Each student must keep his or her own neat and orderly lab notebook using ink. Students are expected enter a "prelab" and all of their data. "Prelabs" should include a summary of the purpose of the experiment, theory and equations and a detailed description of the methods to be used. They are an introduction which may be used when writing your report. Before beginning the experiment the TA will check your prelab. If your prelab is incomplete you will not be able to begin the experiment.</p> <p>Please put your name and a date on every notebook page you use. In addition, be sure to include data labels and units on all tables and graphs. Drawing chemical structures and balanced chemical reactions in your notebook "prelab" (and in your Lab Reports) is highly encouraged. Your notebook must be signed and dated by your TA at the end of any day you spend working in the lab. Notebooks will be periodically checked and suggestions will be made as to how the student can improve their notebook. Since the notebook pages are included as an appendix in the lab report they will count for 10% of the lab report grade.</p>

Exams	<p>Most of the information presented in lectures is expected to serve as a theoretical basis for understanding the experiments. Since this one semester course compliments a full two semester physical chemistry course only a brief summary of the theory can be presented. Although much of the lecture material can be found in the relevant chapters of the GNS text, additional complimentary material can be found in textbooks on physical chemistry or instrumental analysis. Students are expected to take notes during lecture and use these as a basis for studying for the exams.</p> <p>One midterm and one comprehensive final exam will be given.</p>
Presentations	<p>Each student will be expected to give a 20 min presentation. The topic should cover an application of physical chemistry. The instructor will post a list of suggested topics. However, you are encouraged to pick your own instructor-approved topic. Topics must be submitted to the instructor for approval on or before 3/31/2025. The instructor will give you feedback on your presentation and based on the time and quality of your presentation you will receive a score between 1-5 (1 is the best).</p>

Grading (credit) Criteria	<p>The course grade will be based on student performance with respect to: 8 lab reports (50%); midterm exam (20%); presentation (10%); comprehensive final exam (20%).</p> <p>above 97 A+</p> <p>93(inclusive)-97 A</p> <p>90 (inclusive)-93 A-</p> <p>87(inclusive)-90 B+</p> <p>83(inclusive)-87 B</p> <p>80(inclusive)-83 B-</p> <p>77(inclusive)-80 C+</p> <p>73(inclusive)-77 C</p> <p>68(inclusive)-73 C-</p> <p>65(inclusive)-68 D+</p> <p>60(inclusive)-65 D</p> <p>55(inclusive)-60 D-</p> <p>below 55 F</p>
Extra Credit	None
Late Work	Make-up of lab periods/experiments missed (for valid medical or emergency reasons) will be attempted based on the constraints of the apparatus and professor/TA's availabilities.
Absences	Frequently you will have more than enough time to complete an experiment. Since students work in groups (3 or 4), all students must be present and have their notebooks signed in order to share the data.
Class Attendance	<i>It is typical for the class activities to utilize the entire 225 minutes of class time such that one cannot simultaneously enroll in other classes whose meeting days and times conflict with those of CHEM 4473.</i>
Classroom Citizenship	<i>vide supra</i>
Field Trip Policies Off-Campus Instruction & Course Activities	<p><i>Off-campus, out-of-state, and foreign instruction and activities are subject to state law and University policies and procedures regarding travel and risk-related activities. Information regarding these rules and regulations may be found at the website address http://www.utdallas.edu/BusinessAffairs/Travel_Risk_Activities.htm. Additional information is available from the office of the school dean. Below is a description of any travel and/or risk-related activity associated with this course.</i></p> <p>None</p>
Technical Support	If you experience any problems with your UTD account you may send an email to: assist@utdallas.edu or call the UTD Computer Helpdesk at 972-883-2911.
UT Dallas Syllabus Policies and Procedures	<p>The information contained in the following link constitutes the University's policies and procedures segment of the course syllabus.</p> <p>Please go to http://go.utdallas.edu/syllabus-policies for these policies.</p>

All descriptions and timelines are subject to change at the discretion of the instructor.

APPENDIX A
LABORATORY SCHEDULE

First Period of Experiments for CHEM 4473

Molar Volumes (Exp 9)	CD of Protein denaturation (handout)	Kinetics MB/Asc acid (handout)	Bomb Calorimetry ^b (Exp 6)	Dates	Report due
*1	2	3	4	2/10-2/12	21-Feb
4	1	2	3	2/17-2/19	28-Feb
3	4	1	2	2/24-2/26	7-Mar
2	3	4	1	3/3-3/5	14-Mar

Second Period of Experiments for CHEM 4473

Absorption of Conjugated Dyes (Exp 34)	Light Scattering Experiment (Exp 33)	Rot-Vib Spectroscopy of HCl/DCI (Exp 37)	NMR Signal Optimization (handout)	Dates	Report due
1	2	3	4	3/24-3/26	4-Apr
4	1	2	3	3/31-4/2	11-Apr
3	4	1	2	4/7-4/9	18-Apr
2	3	4	1	4/14-4/16	25-Apr

*The numbers in each cell refer to group numbers. Each group of four will generate their own set of data. You must be present in order to use data to generate your report. TAs will keep track of who is present for each experiment. There is no lab the week of 3/17.

^bCD experiment is online