CHM4411L: Physical Chemistry Laboratory

Fall 2024 2 credit hours

Class Number(section): 23893(PL10), 11089(PL11), 11090(PL12), 26435(PL13)

M Period 5 (11:45 - 12:35) LEI 242   ;   T W R F 6-10 (12:55-18:00) LEI 248

No (specifically) Required Textbook: Notes for this course will be provided online; Complete understanding of the activities will require external resources to be sourced by the individual. It is assumed and required that you have access to a typical Physical Chemistry textbook, such as the one used in CHM4411.

Contact Brucat if you have questions...

Instructor: PJ Brucat
- Office hours (subject to optimization):
    Mon 10:30-11:30 ; Fri 08:30-09:30
    or by appointment (message three choices)
- Contact method: *Canvas Messaging* <u>only</u>

TA: TBA
    TBA
    TBA

Course Website:
    https://ufl.instructure.com/courses/

All communication and activities related to this course will be accessible from within UF's campus-wide eLearning system (Canvas) at the URL above. Please become familiar with our course website as soon as possible. Much of the materials there are be subject to revision, so pay careful attention to all announcements, updates, and revision dates. *It is strongly advised that hardcopy or static downloads of course materials be avoided due to their continuous incremental improvement.*

FALL SEMESTER 2024

	S	M	T	W	T	F	S
					Registration ----Drop/Add---		
Aug.	18	19	20	21	22	23	24
			-----Drop/Add------				
	25	26	27	28	29	30	31
Sept.	1	Holiday 2	3	4	5	6	7
	8	9	10	11	12	13	14
	15	16	17	18	19	20	21
	22	23	24	25	26	27	28
	29	30					
Oct.			1	2	3	4	5
	6	7	8	9	10	11	12
						Homecoming 18	19
	13	14	15	16	17		
	20	21	22	23	24	25	26
	27	28	29	30	31		
Nov.						1	2
	3	4	5	6	7	8	9
	10	Holiday 11	12	13	14	15	16
	17	18	19	20	21	22	23
				-----Holiday-----			
	24	25	26	27	28	29	30
Dec.	1	2	3	4	Reading Days 5	6	7
						Commencement	
	8	9	10	11	12	13	14
		Grades Due 16	Deg. Cert. 17	18	19	20	21
	15						
	22	23	24	Holiday 25	26	27	28
	29	30	31				

Etiquette

Your polite, courteous, and civilized behavior is expected in all aspects of our course. Be Human. Be good to each other. Smile.

Goals and Objectives

Course Goals

The purpose of this course is to augment, reinforce, and complement the concepts and topics covered in the CHM4411 "Thermodynamics and Kinetics" lecture course.

Successful completion of this course will enable the learner to:
– Apply the Scientific Method to the Investigation of the Natural World.
– Synthesize the concepts of Thermodynamics, Transport, and Kinetics (Topics in CHM4411) into Testable Hypotheses.
– Master the Basic Concepts of Experimental Design.
– Apply Modern Computational Tools to Diverse Data Analyses
– Communicate Scientific Observations and Conclusions Concisely and Effectively

Course Objectives

Accomplishment in the course material will be assessed in the following:

Knowledge

– Statistical Methods in Extracting Model Parameters from Quantitative Observation
– Basic Elements of Scientific Programming
– Proper Conventions and Requirements for Rendering Scientific Observations

Skills

– Collection and Manipulation of Data
– Creation of Publication-Quality Figures
– Authoring High-Quality Short Reports/Executive Summaries

Course Operation

Course Meetings

There are two meeting types intrinsic to the learning experience of this course.

1. **Lectures** This course has regularly-scheduled meeting times designated for synchronous meetings of the entire class. These meetings are a one-on-many environment primarily for discussion and explanation of new material outlined in the course Attendance at these meetings is *required*. UF attendance policies are in effect. If you fail to absorb information from these discussions, you will have difficulty completing the laboratory challenges and/or submitting quality assignments.

2. **Laboratory Sessions** The actual experimentation will take place in the PChem Teaching Laboratory, LEI 248. It should go without saying that physical attendance in the lab session is *required*. If you are unable to attend the lab session, notify the instructor as soon as possible prior to that session. If the absence is allowable by University policy https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/, a makeup session will be arranged. No grade points will be awarded for any assignment associated with a session you did not attend.

Communication with your Instructor

To guarantee rapid, reliable, and secure transmission, all course communications with your instructor(s) are to occur within the Canvas environment using the embedded tools. Configure your Canvas account profile for immediate automatic notification of course announcements and updates, and make sure that email forwarding, if desired, is set up correctly. It is expected that all replies to messages between instructor and student occur within 24 hours. Responsibility for receiving and responding to electronic course communication in a timely fashion is entirely that of the student.

Groups

Laboratory activities will be undertaken in groups of two. Your group designation will determine the laboratory activity schedule. Group assignments may be found in the course Canvas website.

You are expected to work professionally and efficiently with your group partner. Troublesome partnerships will suffer from poor subjective grades.

All graded assignments will be be worked and submitted as individuals. Clearly, data sharing and other collaboration is expected between the group members, but copying assignment submissions or other is not allowed. Assignment submission are to be your own original work. Plagiarism in any way is a violation of UF's Honor Code.

Graded Assignments

Analysis Quizzes (AQ)

For each lab activity, short question sets will be delivered online through our course website. These are intended to be *formative* assessments, in that these activities focus on and cement concepts in the learner's mind. These quizzes are entirely based on material relevant to the analysis and interpretation of your observations, and should be helpful in the crafting of your ES report, *vide infra*. Any resources may be used to solve these quiz problems, as long as they are worked entirely individually, without consultation with anyone except your instructors. You may discuss the quiz *only with your instructors* until after the due date has passed for everyone in the class.

Python/Jupyter Notebook (NB)

Data visualization and quantitative analysis is key to any experiment, and the Scientific Method in general. The Jupyter notebook environment, running a Python3 kernel, will be used for processing the numerical results of the guided inquiries of the lab. No, Excel or other spreadsheet programs will not be sufficient. Students will submit Python notebooks to our class Jupyter server as part of their reporting. Fear not. No prior programming experience is necessary to master the creation and use of these notebooks. Extensive hints and templates will be provided.

Executive Summary (ES)

After each lab session you will be asked to report your observations. This will be in the form of an *executive summary* of the hypotheses, procedures, findings, and conclusions. Some form of data analysis and graphical representation, usually in the form of publication-quality captioned figures will be required. The ES is a shorter, more focused, and less formal than a typical journal publication.

Each ES will be submitted to the appropriate Canvas assignment page the format requested for grading. Some materials may be need to be authored on or uploaded to the class Jupyter server. Submissions not in the format requested will be ignored.

Laboratory Activity Schedule   (Tentative; see course website)

Week	Date	Lecture	Group ID -G1	-G2	-G3	-G4
0	08/19	-	-	-	-	-
1	08/26	01	PDA	PDA	PDA	PDA
2	09/02	-	PDB	PDB	PDB	PDB
3	09/09	02	PT	PT	PT	PT
4	09/16	03	CEA	CEA	CEA	CEA
5	09/23	04	CEB	CEB	CEB	CEB
6	09/30	05	AE	AE	AE	AE
7	10/07	06	ARA	ARA	ARA	ARA
8	10/14	07	ARB	ARB	ARB	ARB
9	10/21	08	HPA	HPA	HPA	HPA
10	10/28	09	HPB	HPB	HPB	HPB
11	11/04	10	PKA	PKA	PKA	PKA
12	11/11	-	PKB	PKB	PKB	PKB
13	11/18	11	MU	MU	MU	MU
14	11/25	-	-	-	-	-
15	12/02	-	-	-	-	-

PD* is 'Plotting Data', an introduction to Jupyter/Python and data visualization and regression. The activity will span two weeks, consisting of two lab sessions over Zoom, and two NB assignments.

PT is 'Passive Transport', a study of the migration of ions through a membrane as a result of a concentration gradient.

CE* is 'Chemical Equilibrium', the analysis of aqueous equilibrium by simultaneous conductometry and pH and pH measurement. This is a two session activity (A and B) which will include a ES report, a NB, and a quiz.

AE is 'Adiabatic Expansion', a quantitative study of expansion and compression processes in gases and the extraction of heat capacity information.

AR* is 'Acoustic Resonator', the thermodynamic study of sound in various gases. Several types of types of acoustic spectroscopy will be explored, revealing common features of all spectroscopic methods. Heat capacity information will be extracted and compared with the AE activity. This is a two session activity (A and B) which will include two reports, as well as a quiz.

HP* is 'Heat Pump', the analysis of the performance of a thermoelectric heat pump and its evaluation with respect to maximum thermodynamic efficiency. This is a two session activity (A and B) which will include a draft and final report, as well as a quiz.

PK* is 'Photolysis Kinetics', a study of the reversible photophysics of azobenzene. This is a two session activity (A and B) which will include a draft and final report, as well as a quiz.

MU is a placeholder for any required makeup activities. This activities will be scheduled for individuals based on need.

Assignment Schedule   (Tentative; see course website)

Week	AQ	Due	NB	Due	ES	Due
0	SYLQ	08/26				
1	SAFQ	08/30	NB-PDA	XA+1		
2			NB-PDB	XB+1		
3	AQPT	09/13			ES-PT	X+5
4	AQCE	09/20	NB-CEA	XA+5		
5					ES-CEB	XB+5
6	AQAE	10/04			ES-AE	X+5
7	AQAR	10/11			ES-ARA	XA+5
8			NB-ARB	XB+1	ES-ARB	XB+5
9	AQHP	10/21	NB-HPA	XA+5		
10					ES-HPB	XB+5
11	AQPK	11/08	NB-PKA	XA+5		
12					ES-PKB	XB+5
13						
14	MU	12/02	MU	12/02	MU	12/02

SYLQ is the Syllabus Quiz.

NB-* are a Jupyter/Python notebooks submitted via our class Jupyter server. They are the backbone of the data analysis and visualization for all the activities in the course. In most cases hints and templates will be provided. No previous Python or programming experience is required.

SAFQ is the Safety Quiz. It is based on the materials found on the Resources page under Safety and Waste Management. Stay safe, my friends.

AQ-* are Analysis Quizzes. These cover relevant background material necessary for the enjoyment of the associated activity.

ES-* are Executive Summary reports. These ES report are concise, cogent reports of your hypotheses, observations, and conclusions associated with the activity. These should be self contained, complete, and meet the standards of professional scientific communication.

X*+n This symbol indicates the assignment is due n days after the associated laboratory session. If an activity contains multiple sessions, the specific lab session date (A or B) is indicated.

All 'official' activity dates and grades are posted on the secure course website. Assignments are to be submitted in full by the assignment deadline in the requested format for credit.

Course Resources

Activity Descriptions

Notes guiding and describing course activities are posted on the course website. The expectation is that these notes guide your preparation prior to attending the lab meetings. It is not expected that these notes will be sufficient on their own — This laboratory relies heavily on all the Chemistry that you have learned in all the courses you have taken thus far, and in particular *CHM4411 Thermodynamics and Kinetics*. The lab notes are subject of constant revision, so make sure you are using the latest copy. For that reason, static downloads of the material are discouraged.

Our Jupyter/Python Server: https://jupyter2.chem.ufl.edu

This course will take advantage of modern computational tools to expedite mathematical derivations, process experimental data, and render hypotheses graphically. The platform most often used by professionals to easily and effectively interface with the widest variety of these tools is the Python programming language executed in a Jupyter notebook. Such an environment can be implemented on any device from a cell phone to a supercomputer cluster, and is done so routinely.

In order to aid in the mastery of such an environment, a course JupyterHub server has been set up for students in this course. It can be accessed with a web browser through the private URL https://jupyter2.chem.ufl.edu. This platform does not require any installation on your personal device although someday you will want to do that. Things to note:

- The servers address is only accessible on the UF campus network. If you are off campus or otherwise not connected to the campus network, a VPN tunnel must be initiated prior to connection. This is similar to the library database and other services protected by the UFIT firewall. If you are not familiar with the use of VPN, see https://it.ufl.edu/ict/documentation/network-infrastructure/vpn/.

- If you are registered for this course, an account has been created for you using your Gatorlink Username (GLID) as a login. (Your GLID is the name before the '@' symbol in your '@ufl.edu' email address) However, the password for the course server is NOT your gatorlink password. Your password will be <u>set</u> upon your <u>first login</u>.

    - <u>Do not</u> use the same password as your gatorlink credentials.
    - <u>Do</u> remember your password. If you forget your password, the reset process may cause a loss of your work.

- Use of our class server will expedite the instructor's ability to assist student mastery of the tools needed to make Physical Chemistry fun and easy. If you with to use your own Pyhon instance, you still may need to upload your work to the class seerver for evaluation.

Grades

Course Grade Computation

Course grades will be computed from the weighted-average of the earned percentages of each graded items described under Course Activities, submitted by the individual student. The weighting factors of the activity categories are as follows:

Default Category Weights

Grade Category	weight %
Analysis Quiz (AQ)	20
Jupyter/Python Notebook (NB)	20
Executive Summary (ES)	40
Professional Behavior (PB)	20

The grading scheme will generate a aggregate assignment percentage, which will be converted into a letter grade as follows:

Course Letter Grade Percentages

Grade	A	A−	B+	B	B−	C+	C	D	E
Minimum percentage	87.5	80.0	77.5	72.5	70.0	67.5	60.0	50.0	< 50.0

Professional Behavior

Students are expected to be prepared for each lab session, follow instructions, adhere to all safety protocols, keep an accurate and complete lab notebook, respect their colleagues, and, overall, *act in a professional manner*. At the end of the term, students will be graded as to their performance in the above criteria. Throughout the term, instructors will provide feedback as to their assessment of the students professionalism.. This grade category will have mean value of 75% for the class.

Regrade Requests

Grade accuracy is a high priority for this course. Assignments will be regraded if a grading error is suspected. Regrade requests from students must be submitted through Canvas Messaging to Brucat within 48 hours of the grade post. Regrades will be performed on the entire assignment following the standard assignment rubric. Grade adjustments may be positive or negative.

UF's Grading Policy

See https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

Student Resources

The best place to find all resources available to UF students in a wide range of topics, including mental and physical health, advice on academic and financial matters, violence prevention and more, is: https://one.uf.edu/whole-gator/discover

Specific resources, somewhat redundant to the above, are included below, for completeness.

Honesty and Truthfulness

Ethical, moral, and professional behavior is expected and required of all participants in this course. Moreover, all participants in UF's Academic activities are bound by Rules of Conduct, from which can be found the following excerpt:

"UF students are bound by The Honor Pledge which states,

'We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code.'

On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied:

'On my honor, I have neither given nor received unauthorized aid in doing this assignment'

The Honor Code (http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class"

Accommodations

The Disability Resource Center at UF offers this advice:

"Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the Disability Resource Center by visiting our Get Started page. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester."

Counseling

Useful non-academic services are available in many forms at UF.

- U Matter, We Care: If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575 so that a team member can reach out to the student.
- The Counseling and Wellness Center: http://www.counseling.ufl.edu/cwc/

GatorEvals

The UF course evaluation policy includes the following statement:

"Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/."

All course policies and procedures are subject to change at any time at the sole discretion of Brucat

We, the members of the University of Florida Community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity

— Revision: July 23, 2024—