

FUNDAMENTALS OF PHYSICAL CHEMISTRY

Fall 2018

Instructor: Professor Christopher Dares (cdares@fiu.edu)

Schedule: TR 11:00 am – 12:15 pm; in CP117

Office: CP338A

Office Hours: Wednesdays 9:30 – 10:30 am, or email for an appointment

Textbook: “Elements of Physical Chemistry” by P. Atkins, and J. de Paula, 6th or 7th Edition.

Additional: Handouts as necessary

Course Website: faculty.fiu.edu/~cdares/teaching.html

COURSE DESCRIPTION

CHM3400 provides a one semester course covering the fundamental topics in physical chemistry. This includes understanding how chemical processes occur. We will cover: Thermodynamics to determine the conditions (temperature, pressure, pH, etc) necessary for a chemical reaction to occur; **Kinetics** to quantify, predict, and model rates of reactions; and **Quantum Mechanics** to provide you with a fundamental understanding of the nature of the interactions between atoms within molecules, and the resultant properties of these molecules.

Prerequisite

MAC2311 and MAC2312 (calculus); PHYS2048 or PHYS2053, PHYS2048L, PHYS2049 or PHYS2054, PHYS2049L; CHM3120, CHM3120L; or permission of the instructor.

LEARNING OBJECTIVES

The goal of the course is to provide you with the necessary tools to understand the conditions that affect whether a chemical process may occur, and if so, to what degree. This includes thermodynamic considerations, kinetic models to quantify and predict these processes, and quantum mechanics to understand the nature of the fundamental interactions between atoms within molecules.

During the course, students will:

1. **Create a conceptual framework for thinking about chemical processes**
2. **Develop approaches to solve problems, and self-evaluate your approach**
3. **Develop team building qualities by working with others to build understanding and expertise**

TENTATIVE SCHEDULE (CHANGES MAY OCCUR)

Class#	Date	Topic	Chapter
1	Aug 21	Properties of Gases: Ideal Gases	1
2	23	Properties of Gases: Real Gases	1
3	28	The First Law of Thermodynamics: Conservation of Energy	2
4	30	The First Law of Thermodynamics: Internal Energy and Enthalpy	2
5	Sep 4	Applications of the First Law: Physical Changes	3
6	6	Applications of the First Law: Chemical Changes	3
7	11	The Second Law of Thermodynamics: Entropy	4
8	13	The Second Law of Thermodynamics: Gibbs Energy	4
9	18	Physical Equilibria of Pure Substances: Thermodynamics of Transitions	5
10	20	Physical Equilibria of Pure Substances: Phase Diagrams	5
11	25	EXAM 1	1-4
12	27	Properties of Mixtures: Thermodynamics	6
13	Oct 2	Properties of Mixtures: Colligative Properties	6
14	4	Properties of Mixtures: Phase Diagrams	6
15	9	Equilibrium: Thermodynamic Considerations	7
16	11	Equilibrium: Responses to Conditions	7
17	16	Ions in Solution	9
18	18	Electrochemistry: Thermodynamic Considerations	9
19	23	Electrochemistry: Coupled Electron Transfers	9
20	25	Chemical Kinetics: Reaction Rates 1	10
21	30	Chemical Kinetics: Reaction Rates 2	10
22	Nov 1	EXAM 2	10
23	6	Temperature Dependence on Reaction Rates	5-7,9
24	8	Chemical Kinetics: Rate Laws	11
25	13	Rate Laws and Reaction Mechanisms	11
26	15	Quantum Theory: Introduction and Molecular Motion	12
27	20	Quantum Chemistry: The Hydrogen Atom	12
	22	NO CLASS - Thanksgiving	
28	27	Quantum Chemistry: Many-electron Atoms	13
29	29	Spectra of Complex Atoms	13
30	Dec 3-8	FINAL EXAM – TBD	1-13

GRADING

While changes may be made, the approximate conversion between your final course grade percentage and letter grade is as follows:

85.0 % – 100 %	A	73.0 % – 74.9 %	B	55.0 % – 64.9 %	C
80.0 % – 84.9 %	A-	70.0 % – 73.0 %	B-	50.0 % – 54.9 %	D
75.0 % – 79.9 %	B+	65.0 % – 69.9 %	C+	< 50.0 %	F

Your course grade will be determined from four components:

I.	Class participation	10 %
II.	Homework: Problem Sets	10 %
III.	In-class Exams (2)	40 %
IV.	Final Exam: TBD	40 %

EXAMS

Two equally weighted in-class exams will be given. One final exam will be given. The final exam will be cumulative, covering all of the material from the semester. Note that the final exam date is fixed and cannot be changed; make sure that your schedule can accommodate the exam time.

MISSED EXAM POLICY

No makeup exams will be given. In the case of a missed in-class exam, your percentage score on the Final Exam will be used instead. The Final Exam is cumulative, so the material covered on the missed exam will be (partly) included in the Final Exam. If a conflict or medical problem arises, feel free to contact the instructor to discuss the situation.

PROBLEM SETS

Roughly six problem sets will be assigned during the semester. Problem sets are due before the start of class on the due date! Submissions received after the start of class will have 50% taken off. Submissions received after class on the due date will not be graded — score of 0 will be given. No e-mail submissions will be accepted.

NOTES AND CLASS TIME

The course will be taught through presentation slides projected on a screen and board work. Slides will be posted on the website ahead of time.

RESEARCH EXPOSURE

CHM3400 strives to introduce you to fundamental physical chemistry concepts, and to provide in a greater context, ongoing research at FIU and the resulting technology products that results from research efforts around the world. Please visit the course website at to learn about how you might engage in research, scholarship and creative performance while you are at FIU. Projects introduced during the semester will involve research into the primary chemical literature and the development of interacting learning tools. If you are interested in performing undergraduate research, contact the instructor to learn more.

STUDYING

The course covers a wide range of chemistry. Review your notes daily (don't wait until the night before an exam to study!) and work practice problems from textbooks. Studying in groups is encouraged, but

each student must turn in their own independent problem sets. Make sure you are not relying on others in your study group: they won't be there to help you on the exam. The website will feature a bulletin board where you can post questions that Prof. Dares or your classmates can weigh in on. Please note: Prof. Dares is unable to respond to e-mails regarding course content; please do e-mail about setting up a one-on-one meeting to discuss any aspect of the course.

COURSE WEBSITE

Please refer to the course website (faculty.fiu.edu/~cdares/teaching.html) for all class assignments and announcements as well as the syllabus and exam schedule.

CLASS CITIZEN ETIQUETTE

Please be respectful: **turn off cell phones and computers and focus on the material.** If you use your computer/tablet, please sit at the back so as to not interfere, disrupt, or distract others. Students whose behavior is detrimental to the learning environment will be asked to leave.

EMAIL POLICY

Prof. Dares is looking forward to hearing from you! Before you click "send" please read the following guidelines: (a) please be sure that your subject starts with the header "CHM3400"; and (b) please refrain from asking content-based questions. Fundamentals of Physical Chemistry covers a variety of complex topics, none of which are easily addressed in writing over e-mail. These topics are best addressed in person, at office hours. If the normal office hours conflict with your schedule, please e-mail to set up an appointment.

HONOR CODE

The Honor Code is the cornerstone of academic integrity at FIU. Students are expected to uphold and abide by the Honor Code. **All suspected Honor Code violations will be reported promptly. No collaboration is permitted on graded work** because these assignments will be used to determine academic progress. When collaboration is permitted an explicit statement encouraging teamwork will be made. As discussed elsewhere in the syllabus, studying in groups is encouraged; however, graded assignments must be your own independent work.

HOW TO SUCCEED IN THIS COURSE

- **Come to class prepared.** This is a no-brainer. Read the assigned textbook chapters or handouts before lecture. Most class sessions will start with a clicker question about the assigned reading.
- **Study in groups.** Study groups are effective when everyone collaborates and works hard. Study groups are encouraged, but remember that each student must submit his or her own work. Beware of false confidence when the group arrives at answers that you don't fully understand!
- **Get help early.** If you are having problems with the material, seek help early in the semester. Halfway through the course is way too late.

DISCLAIMER

The instructor reserves the right to make changes to the syllabus, including assignment and test dates (excluding the officially scheduled Final Exam), when unforeseen circumstances occur. These changes will be announced as early as possible so that students can adjust their schedules.