2025 Spring 01:160:341
Physical Chemistry I: Biochemical Systems

Course OVERVIEW

This is the first part of a two-semester physical chemistry course that focuses on applications to biochemical systems and life sciences. **This part is independent of the second part (160:342), which will be offered in the Fall semester.**

For this semester's study material, we will be using the book "Physical Chemistry for the Life Sciences, Third Edition" by Peter Atkins, Julio de Paula, George Ratcliffe, and Mark Wormald. This comprehensive text is tailored to address the specific needs of students in life sciences and will provide valuable insights into the application of physical chemistry principles. Throughout the course, we will cover Focus 1 to Focus 7 from the textbook, following a chronological order to align with the concepts presented in the book, focusing on understanding the **physical principles** and the **biological applications** of these concepts. The goal of the class is (1) to learn to think quantitatively about biological measurements and (2) to understand how quantitative biophysical and biochemical measurements are made.

Detailed reading assignments will be provided progressively as we progress through the class. Below is a tentative time schedule for the topics we will cover:

Current class schedule

Class meeting time/room: **Monday/Wednesday, 3:50PM to 5:10 PM**; Busch Campus SEC-212

Instructor Information

Instructor #1: Zheng Shi

Email: zheng.shi@rutgers.edu

Office Location: **CCB-4220**

Department of Chemistry and Chemical Biology

Office Hours: **Thursday, 12:00 pm – 1:00 pm** (by appointment only).

Instructor #2: Tai-Sung Lee

Email: taisung@rutgers.edu

Office Location: **Room 308C**

Institute for Quantitative Biomedicine at Rutgers Busch Campus

Office Hours: **Thursday, 12:00 pm – 1:00 pm** (by appointment only).

Communication:

Throughout the semester, the instructors will communicate via **Canvas Announcements** or your **Rutgers email account**. Please review the following link for Accessing Rutgers Email:

https://canvas.rutgers.edu/documentation/general/accessing-rutgers-email/

General Course Description

Course Format:

This course will have two lectures on Monday and Wednesday. This course will have **one midterm exam** (80 minutes duration, held during class time) and **one cumulative final exam** (3 hours duration).

In the first 15 meetings before the Spring break, we will cover Focus 1 to Focus 4 of the textbook. Except for the first and 15th meetings (the in-class mid-term), in each class meeting there will be a 10-minute quiz covering the previous meeting material. The homework assignment, along with the solutions, will be updated promptly on the Canvas site. There is no need to turn in homework. Nevertheless, the quiz will mainly be based on the homework assignment. The quizzes will contribute to 10% of the final grade based on the best 10 out of 13. The in-class midterm will have a 20% contribution to the final grade.

In the second 13 meetings after the Spring break, we will cover Focus 5 to Focus 7 of the textbook.

There will be a few homework assignments throughout the second half of the course. Homework assignments will generally be released before the beginning of a new chapter and will be due according to the schedule. You may collaborate with each other on the homework problems, but each student must independently complete and turn in their own assignment.

There will also be **a final project** focusing on *how a physical chemistry approach can be applied to study a problem in biology*. Students will extensively and critically review a topic related to this course, or propose a new experiment, or develop a new physical chemistry model for a known biological phenomenon. Each student will give a ~15 min presentation to the class followed by 5~10 min in-class discussion. The presenter is expected to address questions that arose during the discussion.

The exams and project presentation dates can be found here in the current class schedule. Students are responsible for making it to the exams on time – there will be no make-up quizzes or exams. The class period before each exam will be set aside for additional review of the relevant material. Remember to bring the scientific calculator that you know how to use for all exams! Calculators with QWERTY keyboard are not allowed.

Grading:

The grading for this course will be based on your performance on quizzes, homework assignments, course projects, and exams as the following:

First Half	10 (best out of 13) quizzes	10%
	Midterm	20%
Second Half	Homework/quiz	10%
	Project	20%
Cumulative Final Exam		40%
Total		100%

* Bonus points may be given in homework throughout the semester. Details will be announced during class time.

** Topics tested in the midterm will compose 1/2 of the final exam. One may choose to overwrite their midterm grades with their grades in the corresponding section of the final exam.

No grading curves will be used in this course. Your final grade will be based on percentages of total points accumulated (the exact cutoff between letter grades will be determined later in the semester). Participation in lectures and project presentations will be used to decide on borderline final-grade assignments. Any questions or concerns about a graded assignment or assessment should be brought to the attention of the instructor within one week of receiving the grade.

Course Description:

Fundamental principles of physical chemistry: thermodynamics, ideal and nonideal solutions, chemical dynamics, catalysis, electrochemistry, and phase equilibria. Biologically relevant examples and applications are stressed. Credit will not be given for both these courses and 01:160:323-324 or 327-328.

Prerequisites:

- 01:160:160, 162, or 164
- 01:640:251
- 01:750:203-204, or 227 and 228

Course Modality:

This course is delivered **fully on-campus**. To access the companion Canvas course site, please visit Rutgers Canvas at https://canvas.rutgers.edu/ and log in using your NetID. For more information about course access and support, contact Canvas Help at https://canvas.rutgers.edu/canvas-help/, via email at help@canvas.rutgers.edu, or call 877-361-1134.

Materials

Physical Chemistry for the Life Sciences

ISBN: 9780198830108, by Peter Atkins; R. George Ratcliffe; Mark Wormald; Julio dePaula

Attendance:

Students are expected to attend, participate and remain engaged during class. Exams must be taken at the scheduled times. Only excusable reasons will be considered.

To be excused from an exam, you must provide a letter of excuse within 3 days of the exam from your Academic Dean. Unexcused missed exams will result in a score of zero for that exam. For excused exams, the score will be temporarily assigned as zero and will be replaced by the grade in the corresponding section of the final exam.

Special Needs:

Any student requiring extra time and/or other unusual testing accommodations must provide documentation supporting their circumstances and MUST notify the course Instructor. Please do this during the first week of classes or immediately after these needs are documented. ALL

requests for extend time and/or other special accommodations for exams must be handled through the Office of Disability Services (http://disabilityservices.rutgers.edu/). The office of Disability Services will be responsible for all necessary proctoring arrangements.

Academic Integrity

Students must adhere to the university policies on academic integrity and student conduct in all assignments, assessments and other matters regarding this course. These policies can be found online: http://studentconduct.rutgers.edu/academic-integrity/. **The faculty and staff at Rutgers are committed to your success. Students who are successful tend to seek out resources that enable them to excel academically, maintain their health and wellness, prepare for future careers, navigate college life and finances, and connect with the RU community. Resources that can help you succeed and connect with the Rutgers community can be found at success.rutgers.edu, and nearly all services and resources that are typically provided in-person are now also available remotely.**

Additional Course Resources:

A variety of printed and digital content may be provided during the course. Digital content will be found within the **Canvas course site**. There may be additional reading assignments as student interests dictate.

Technology Requirements:

This course may require that you access online resources in the University's Canvas site. Please review the following link for Canvas Student Resources for assistance on getting started in Canvas:

https://canvas.rutgers.edu/students/

Physical Chemistry I (01:160:341) Spring, 2025
Tentative Lecture Schedule

	Date		Topics	Textbook	Conceptual Problems	Numerical Problems
1	1/22	W	Course intro, Work and heat	1A		
2	1/27	M	Internal energy and enthalpy	1B		
3	1/29	W	Calorimetry, Fundamental processes	1C, 1D		
4	2/3	M	Chemical change	1E		
5	2/5	W	Entropy	2A, 2B		
6	2/10	M	Free Energy	2C		
7	2/12	W	Water in transition	3A		
8	2/17	M	The thermodynamic properties of water	3B		
9	2/19	W	The thermodynamic description of aqueous solutions, Water at equilibrium in solution	3C, 3D		
10	2/24	M	The thermodynamic background	4A		
11	2/26	W	The standard reaction Gibbs energy, The response of equilibria to the conditions	4B, 4C		
12	3/3	M	The response of equilibria to the conditions, Proton transfer equilibria	4D, 4E		
13	3/5	W	Water at equilibrium in solution, Ligand binding equilibria	4F, 4G		
14	3/10	M	In-class Midterm			

In-class 10-min quizzes (best 10 out of 12): 10%
Midterm: 20%

	Date		Topics	Textbook	Conceptual Problems	Numerical Problems
15	3/12	W	Review of Midterm?			
16	3/24	M	Review of FOCUSES 1 – 4	1 - 4		PS#5 assigned
17	3/26	W	Debye-Huckel; membrane voltage; Nernst; Goldman;	5A		
18	3/31	M	action potential; galvanic cell; electron transport chain.	5B, 5C		
19	4/2	W	rate laws; reaction order and mechanism;	6A, 6B		PS#6 assigned
20	4/7	M	binding kinetics; protein folding; kinetics and equilibrium;	6B, 6C		PS#5 due
21	4/9	W	Arrhenius equation; transition state; enzyme; diffusion vs. activation.	6C, 6D		
22	4/14	M	Michaelis-Menten; enzymatic reactions;	7A		PS#7 assigned
23	4/16	W	random walk and diffusion; Fick's law; Stokes-Einstein;	7B		PS#6 due
24	4/21	M	diffusion-limited reaction rate; chemotaxis; size of organisms/tumor; diffusion and flow.	7C		
25	4/23	W	Project presentation			
27	4/28	M	Project presentation			PS#7 due
28	4/30	W	Final Review			
			Final Exam (May 14th, 12 pm – 3 pm, SEC 206)			

Homework: 10 %
Project: 20%
Final: 40%